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MAY 1952

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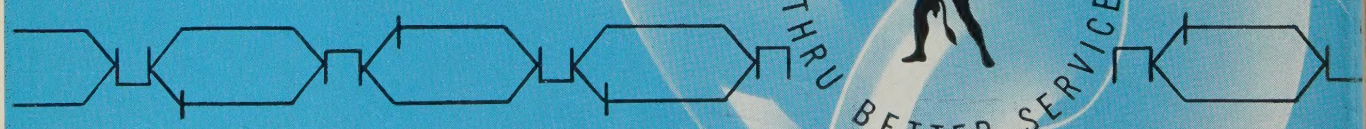

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PP52-3

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The title of the patent is "Paper Pulps and Papers and Process of Making Same".

This patent covers High Yield Kraft Process and "Hot Stock" Refining.

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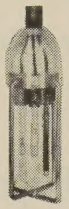

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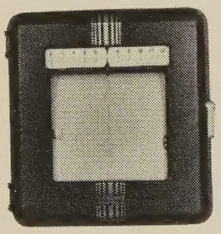

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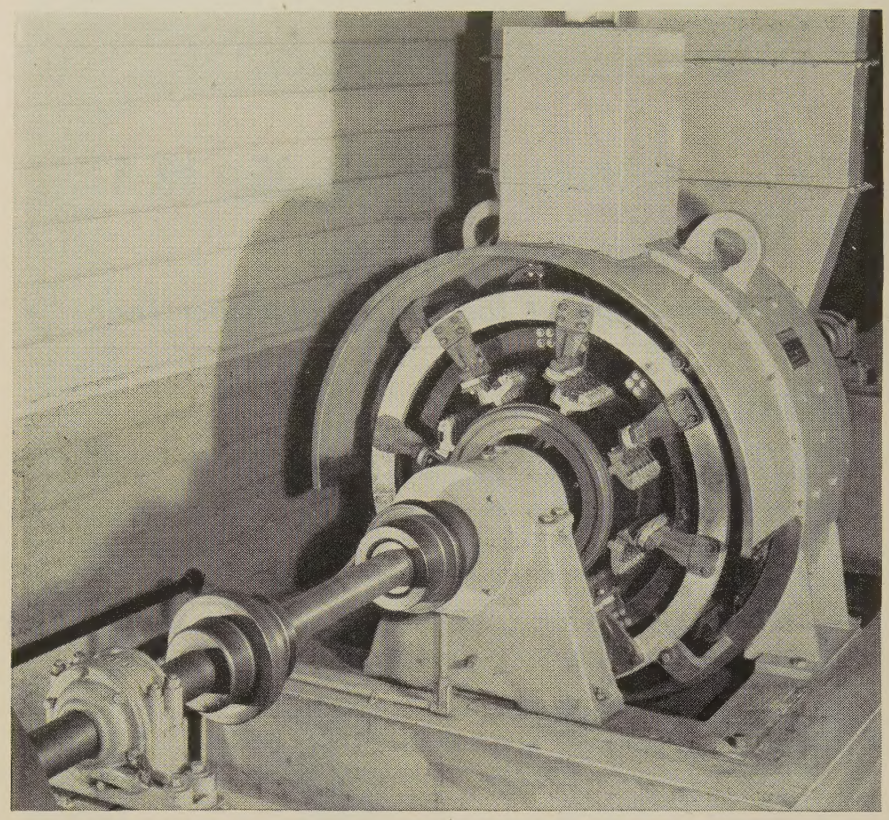
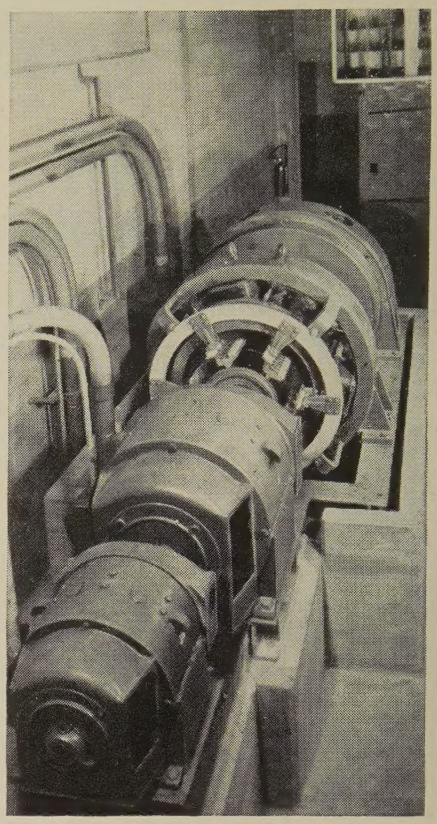


Regardless of load changes, any pre-set speed can be kept with pinpoint accuracy by G-E single-motor drives for lineshaft-driven machines. Simple, flexible operation—with speed ranges up to 10:1 or higher—helps maintain uniform weight and quality of the sheet. At the Camas, Wash., paper mill of the Crown-Zellerbach Corp., this G-E main drive motor for the No. 15 paper machine is rated 900 hp, 600 rpm, 600 volts.



Supplying power to motor at left is this G-E main motor-generator set, including 750-kw d-c generator, 1250-hp synchronous motor, 150-kw auxiliary generator, and 25-kw d-c exciter. All are mounted on a common base for easy installation.

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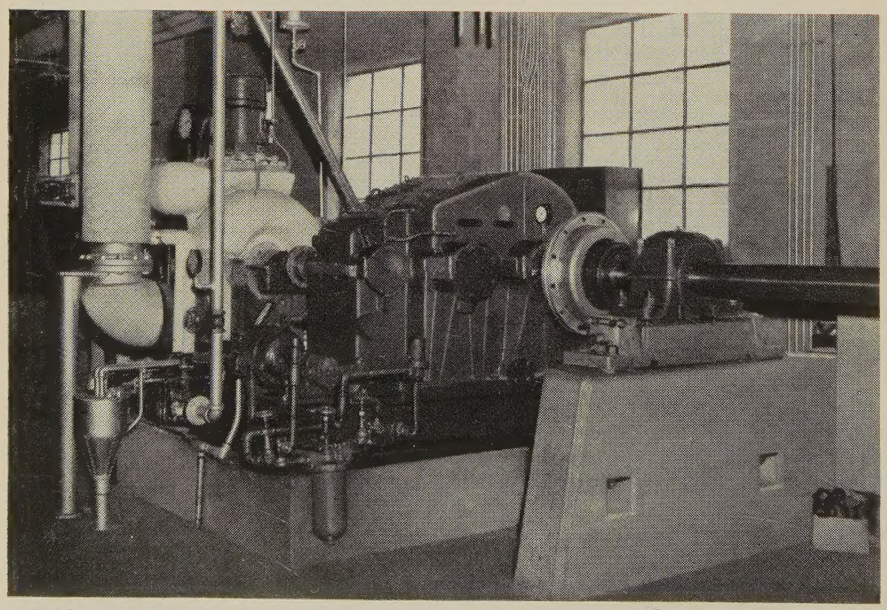

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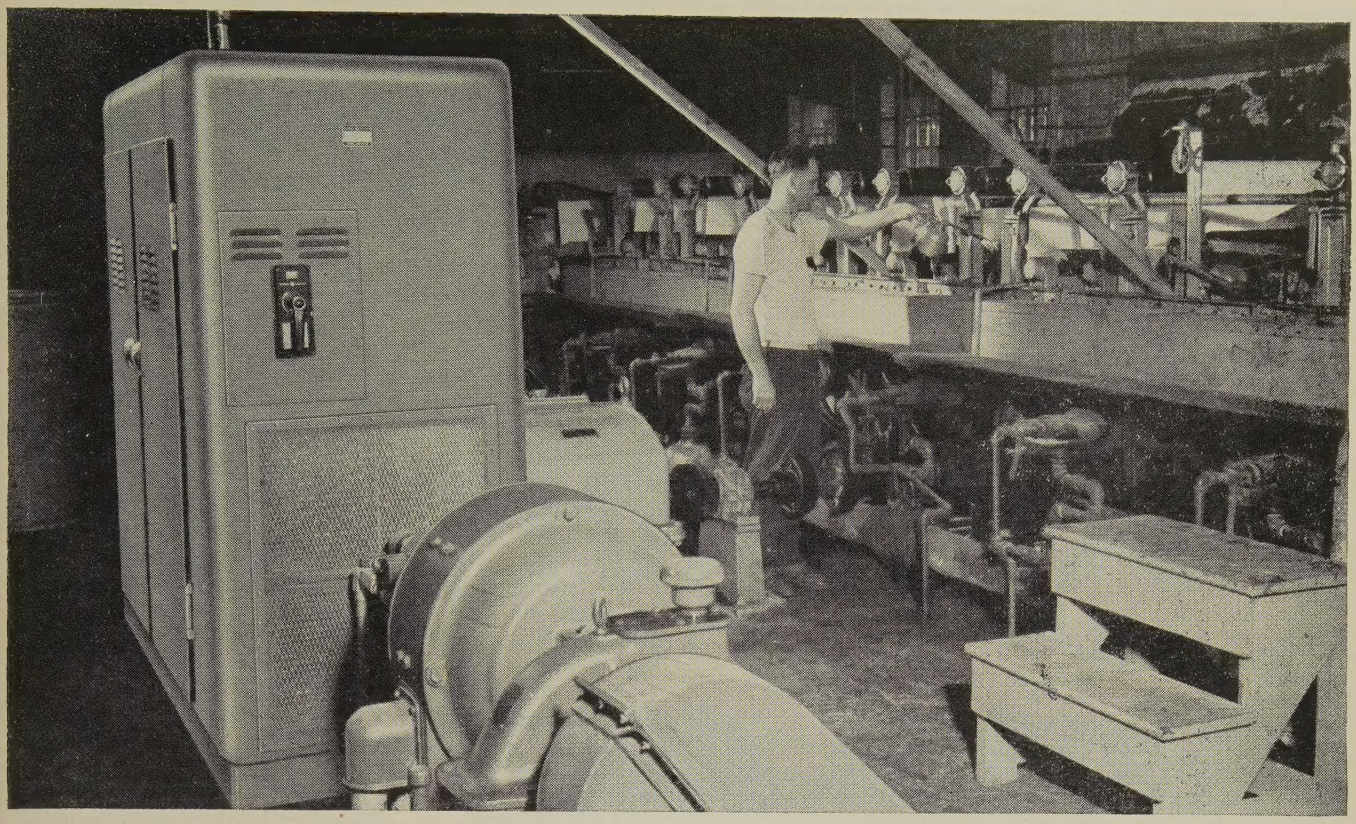

For smaller horsepower drives, easy low-cost installation is one big reason why more and more paper-mill operators are using the G-E Speed Variator single-motor drive. An adjustable-voltage d-c drive operating from a-c power, it includes a packaged power unit that's easy to install, maintain, and re-locate if necessary. At the Bay State paper mill of Crane & Company, Inc., Dalton, Mass., the compact, enclosed Speed Variator power unit—shown here behind its G-E 40-hp d-c motor on a lineshaft-driven paper-making machine—"makes for smoother operation all the way through," say company engineers.

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655-10

PULP, PAPER, AND PAPERBOARD IN THE UNITED STATES

Review for 1951

W. LEROY NEUBRECH

NEW, all-time production highs were recorded in practically every segment of the pulp, paper, and paperboard industry in 1951.

Table I. Statistical Highlights

Item and unit	*12 months* 1951	1950	*Per cent change*
Pulpwood:			
Receipts, 1000 cords	27,764	22,546	+23.1
Consumption, do	26,576	23,627	+12.5
Inventories,[a] do	5,080	3,815	+33.2
Wood pulp (total integrated and market):			
Production, 1000 short tons	16,494	14,808	+11.4
Imports, do	2,370	2,385	−0.6
Exports, do	200	96	+108.3
New supply,[b] do	18,664	17,097	+9.2
Consumption,[c] do	17,704	16,470	+7.5
Inventories,[a, c] do	611	491	+24.4
Market wood pulp (at paper and board mills):			
Receipts, 1000 short tons	2,815	2,911	−3.3
Consumption, do	2,740	2,899	−5.5
Inventories,[a] do	396	332	+19.3
Market wood pulp (at nonpaper mills):			
Receipts, 1000 short tons	731	n.a.	n.a.
Consumption, do	714	n.a.	n.a.
Inventories,[a] do	78	n.a.	n.a.
Waste paper:			
Receipts, 1000 short tons	9,252	7,964	+16.2
Consumption, do	9,079	7,956	+14.1
Inventories,[a] do	588	387	+51.9
Paper and board production:			
Paper, 1000 short tons	11,621	10,641	+9.2
Paperboard, do	11,605	10,925	+6.2
Wet machine, do	144	166	−13.3
Construction paper and board, do	2,716	2,645	+2.7
Total	26,086	24,377	+7.0
Wholesale paper and paper products:			
Sales, 1,000,000 dollars	2,400	2,013	+19.2
Inventories,[a] do	232	205	+13.2

n.a.—Not available.
[a] December, 1951, compared to December, 1950.
[b] New supply equal production plus imports minus exports.
[c] Paper and pulp mills only. Data for nonpaper consumers not included since figures for 1950 unavailable.
Source: Prepared by the Pulp, Paper, and Paperboard Division, National Production Authority, based upon data from Bureau of the Census, U. S. Department of Commerce.

The value of manufacturers' sales of all types of products produced by the industry aggregated $8098 million, an increase of $1427 million over 1950 and $5262 million over 1941. This large gain in value is partly the result of the rise in prices, but at the same time reflects a substantial growth in volume.

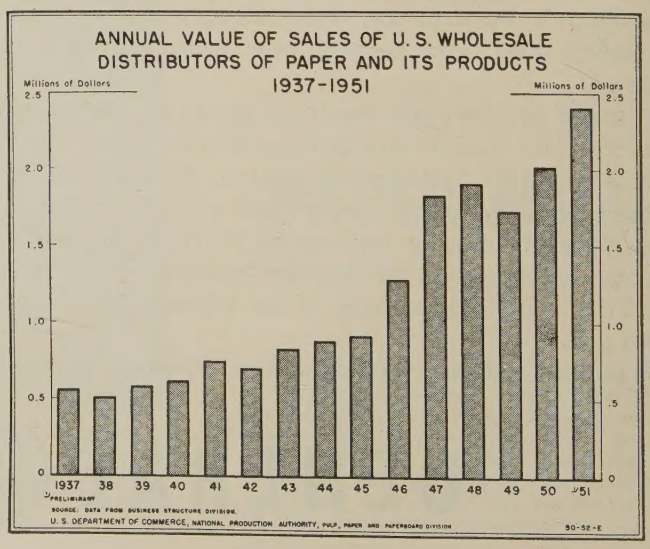
Total paper and board production, including wet machine board and construction paper and board, amounted to 26.1 million tons in 1951, practically twice the volume output of 1939. The previous record years were 1950 with 24.4 million tons and 1948 with 21.9 million tons.

To produce this large output of paper and board required proportionately greater quantities of wood pulp and wastepaper. Wood pulp consumption in 1951, for the manufacture of paper and board, was 17.7 million tons, not to mention the consumption of 714 thousand tons of dissolving and special chemical grades of wood pulp in nonpaper products.

Wastepaper consumption for the first time in history exceeded 9 million tons, more than double that of 1939. This observation is interesting, since during the World War II period the War Production Board set a salvage goal of 8 million tons of wastepaper but achieved something less than 7 million tons. It is obvious, therefore, that should another serious emergency develop, and should wood pulp supplies become critically short, that the United States, under an all-out salvage campaign, could undoubtedly achieve a collection of well over 10 million tons of wastepaper.

Wood pulp production, amounting to 16.5 million tons in 1951, exceeded 1939 by 9.5 million tons. Supplementing domestic output is a substantial import volume totaling 2.4 million tons in 1951. Imports of wood pulp have held fairly steady since 1939 (except for the war years when North European supplies were cut off), but imports from Canada in 1951 gained substantially and offset the decline in imports of wood pulp from overseas.

The sharply upward trend in wood pulp production is reflected in a similar rapid growth in pulpwood consumption which totaled 26.6 million cords in 1951 compared to only 10.8 million cords in 1939. Because of the pressing need for more wood and the uncertainty of the effects of the defense program on logging, the industry put forward strenuous efforts toward pulpwood output, with the result that total receipts (domestic and imported from Canada) were 27.8 million cords in 1951. Translated in terms of board feet, this is equivalent to about 14 billion board feet of lumber. This is equal to about two-fifths of the total United States production of sawn lumber of all types in the United States and clearly illustrates the major importance of the pulpwood industry with regard to the future of forestry practices in the United States. In fact, already, the pulp and paper industry has become a leading factor in private commercial forestry as well as lending close cooperative efforts with the U. S. Forest Service and State forestry departments.


ANNUAL VALUE OF SALES OF U. S. WHOLESALE DISTRIBUTORS OF PAPER AND ITS PRODUCTS
1937-1951
Millions of Dollars
Millions of Dollars
2.5
2.0
1.5
1.0
0.5
0
1937 38 39 40 41 42 43 44 45 46 47 48 49 50 51
PRELIMINARY
SOURCE: DATA FROM BUSINESS STRUCTURE DIVISION.
U. S. DEPARTMENT OF COMMERCE, NATIONAL PRODUCTION AUTHORITY, PULP, PAPER AND PAPERBOARD DIVISION
50-52-E

W. LEROY NEUBRECH, Assistant to Director, Pulp, Paper, and Paperboard Division, National Production Authority, U. S. Department of Commerce, Washington, D. C.

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Production Workers and Wages, Pulp, Paper, and Allied Products Industries

Year	*Average number of wage earners, thousands*	*Total dollar wages, millions*
1899	94	36
1909	145	68
1919	208	213
1929	233	287
1939	265	310
1947	391	953
1948	394	1063
1949	382	1111
1950[a]	404	1284

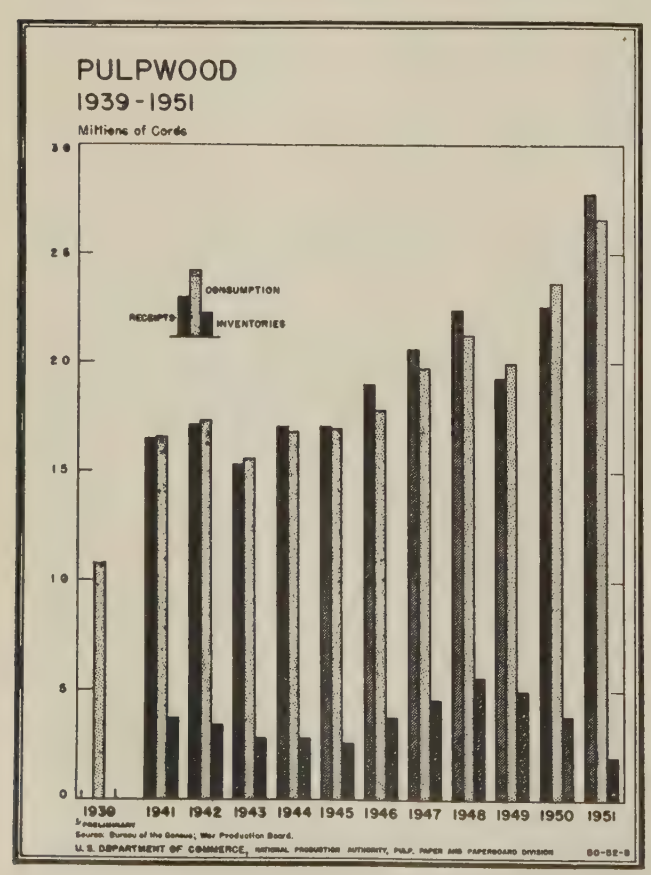
[a] Preliminary.
Source: Bureau of Labor Statistics, Department of Labor. 1949 estimated on basis of monthly data furnished by Bureau of Labor Statistics.

In the field of foreign trade, the industry is also a major factor. In 1951 imports, especially of pulpwood, newsprint, and wood pulp, totaled $958 million while exports of pulp, paper and products amounted to $231 million.

Table II. Pulp, Paper, and Board Highlights

Item	*Unit, millions of*	*1951*	*1950*	*1949*	*1948*	*1947*	*1939*
Pulpwood consumption	Cords	26.6	23.6	19.9	21.2	19.7	10.8
Wood pulp production	Tons	16.5	14.8	12.2	12.9	11.9	7.0
Wood pulp consumption[a]	Tons	17.7	16.5	13.6	14.4	13.3	8.7
Wastepaper consumption[a]	Tons	9.1	8.0	6.6	7.6	8.0	4.4
Paper and board production	Tons	26.1	24.4	20.3	21.9	21.1	13.5
Wood pulp imports[b]	Tons	2.4	2.4	1.8	2.2	2.3	2.0
Newsprint imports	Tons	5.0	4.9	4.6	4.4	4.0	2.6

[a] In manufacture of paper and board only.
[b] Includes rayon and other nonpaper grade pulp.
Source: Bureau of the Census, U. S. Department of Commerce.



As an employer of labor, the industry continues to add to its production workers, so that in 1950 (latest year for which data are now available), over 404,000 wage earners were employed with wages of $1284 million. Wages paid in 1950 were about four times those paid in 1939.

Table III. Total Value of Sales of the Pulp, Paper, Board, and Products Manufacturing Industry

Year	*Millions of dollars*	*Year*	*Millions of dollars*	*Year*	*Millions of dollars*
1939	1785	1944	3629	1948[a]	6060
1940	2064	1945	3725	1949[a]	5448
1941	2836	1946	4469	1950[a]	6671
1942	2965	1947	5764	1951[b]	8098
1943	3389				

[a] 1948–50, revised September, 1951.
[b] Preliminary.
Source: Office of Business Economics, Department of Commerce. The estimated dollar total of sales represents receipts of all operators of paper manufacturing companies. The figures include data for both corporate and noncorporate businesses but are comparable to the sales data for corporations in Statistics of Income published by the Bureau of Internal Revenue.

While a large part of the industry's products are sold to converters or manufacturers of other products for packaging and industrial purposes, or direct to large printers, nevertheless, in 1951 over $2400 million of paper and products were handled by wholesale paper merchants throughout the United States.

Table IV. Total United States Imports and Exports Paper Base Stocks, Paper, and Manufactures

(Millions of Dollars)

Year	*Imports*	*Exports*	*Year*	*Imports*	*Exports*
1939	215	40	1948	754	139
1945	298	102	1949	666	113
1946	419	116	1950	746	107
1947	657	173	1951[a]	958	231

[a] Preliminary.
Source: Bureau of the Census, U. S. Department of Commerce.

Table V. Annual Value of Sales of United States Wholesale Distributors of Paper and Its Products, 1939–51

Year	*Millions of dollars*	*Year*	*Millions of dollars*	*Year*	*Millions of dollars*
1939	575	1944	878	1948	1902
1940	608	1945	909	1949	1723
1941	739	1946	1275	1950	2013
1942	695	1947	1828	1951[a]	2400
1943	823				

[a] Preliminary.
Note: These data are revised to 1948 Census of Business data.

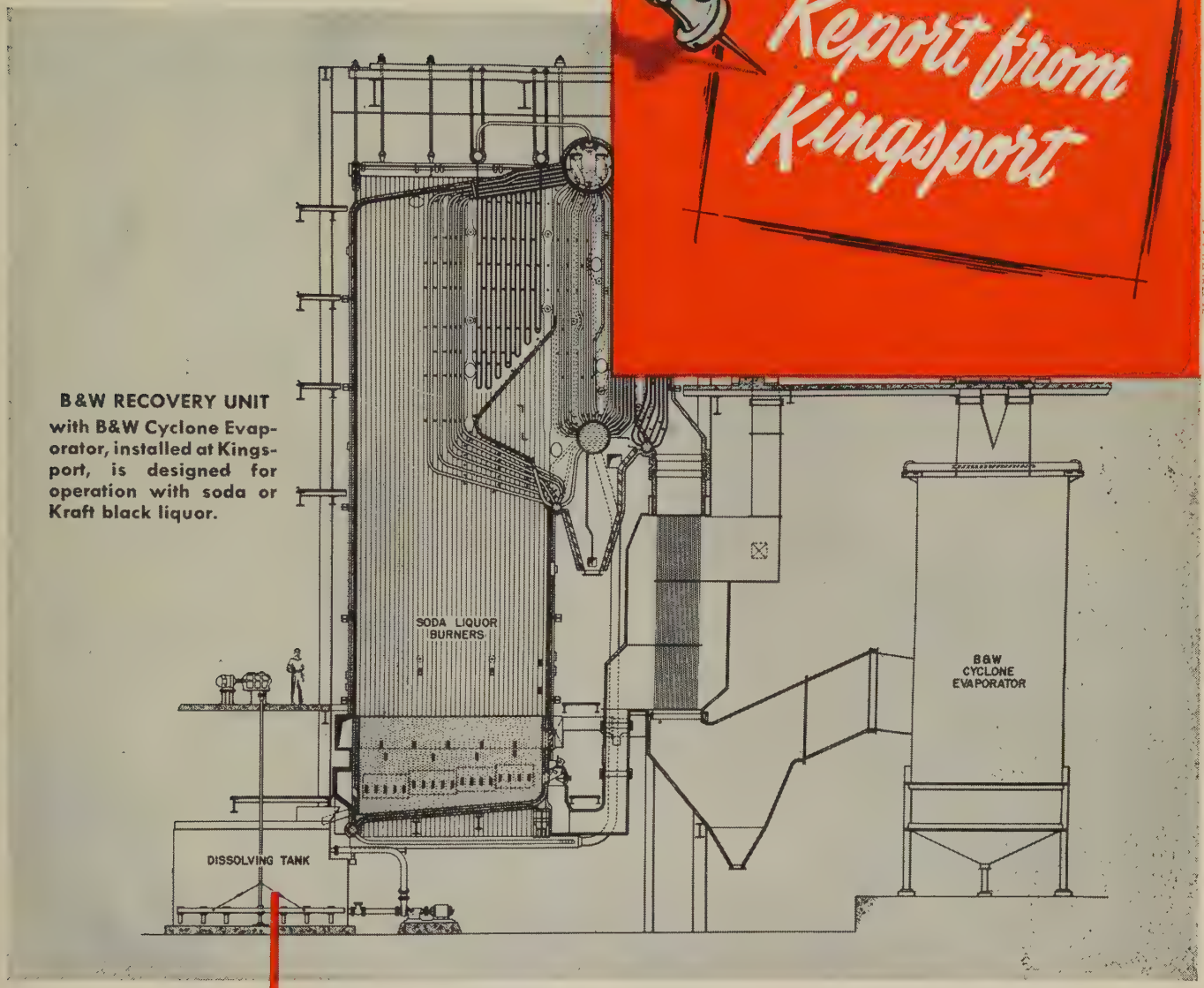
Table VI. Monthly Value of Sales of United States Wholesale Distributors of Paper and Its Products, 1946–51

(Millions of Dollars)

Month	*1946*	*1947*	*1948*	*1949*	*1950*	*1951*
January	88	135	163	148	148	228
February	77	123	152	136	139	198
March	87	134	159	148	151	218
April	92	144	157	137	143	199
May	103	146	151	131	149	211
June	104	151	161	139	162	202
July	104	150	144	125	151	178
August	118	154	163	152	194	208
September	122	176	166	152	186	183
October	136	188	169	154	205	217
November	124	163	162	155	198	194
December	120	164	155	146	187	164
Total	1275	1828	1902	1723	2013	2400[a]

[a] Preliminary.
Note: These data are revised to 1948 Census of Business data.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, from data supplied by Business Structure Division, U. S. Department of Commerce.

Report from Kingsport



B&W RECOVERY UNIT with B&W Cyclone Evaporator, installed at Kingsport, is designed for operation with soda or Kraft black liquor.

Designed to operate on a basis of 240 tons of pulp daily, and generate 107,000 lb. of steam per hr. at 900 psi and 750 F, a B&W Recovery Unit—since installation two years ago—has admirably fulfilled expectations in helping achieve better processing efficiencies and operating economies at the modernized Kingsport, Tennessee, mill of Mead Corporation. Largest recovery unit ever built for the soda pulping process, it was purchased to operate at approximately 60 per cent of its rated capacity, and under these difficult conditions has easily maintained desired heat and chemical recovery rates. The mill reports substantial savings in maintenance time and expense chargeable to recovery units. The new unit requires no hand lancing—automatic soot blowers do the job.

Performance of this unit is another indication of B&W's 75-year-old knack for meeting the specialized needs of pulp and paper mills . . . experience, facilities, and resourceful engineering that can help solve *your* recovery problems.

BABCOCK & WILCOX

P-761

Table VII. Pulpwood—United States Annual Receipts, Imports, Consumption and Inventories

(1000 Standard Cords—Roughwood Basis)

Item	1951[a]	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941
Receipts, total	27,764	22,546	19,266	22,333	20,619	18,978	16,982	16,999	15,292	17,139	16,457
Domestic	25,123	20,712	17,619	20,026	18,542	16,982	15,253	15,349	13,580	14,907	14,176
Imported	2,641	1,834	1,647	2,307	2,077	1,996	1,729	1,650	1,712	2,232	2,281
Northeast, total	4,779	3,295	3,275	4,039	4,135	3,650	3,389	3,039	2,953	3,399	3,487
Domestic	3,132	2,235	2,366	2,666	2,970	2,508	2,311	1,976	1,906	2,238	2,252
Imported	1,647	1,060	909	1,373	1,165	1,142	1,078	1,063	1,047	1,161	1,235
Appalachian, total	1,959	1,705	1,544	1,784	1,623	1,716	1,388	1,482	1,304	1,475	1,412
Domestic	1,959	1,705	1,544	1,763	1,610	1,684	1,365	1,472	1,302	1,448	1,378
Imported	.....	.....	.....	21	13	32	23	10	2	27	34
Lake States, total	3,416	2,472	2,149	3,031	2,900	2,919	2,456	2,638	1,969	2,796	2,241
Domestic	2,625	1,985	1,619	2,344	2,154	2,239	1,954	2,175	1,409	1,983	1,561
Imported	791	487	530	687	746	680	502	463	560	813	680
South, total	12,842	11,543	9,060	9,997	8,227	7,909	7,153	7,090	6,505	6,622	6,400
Domestic	12,842	11,543	9,060	9,997	8,227	7,909	7,153	7,090	6,505	6,622	6,400
Pacific Northwest, total[b]	4,768	3,531	3,238	3,482	3,734	2,784	2,596	2,750	2,561	2,847	2,917
Domestic	4,565	3,244	3,030	3,256	3,581	2,642	2,470	2,636	2,458	2,616	2,585
Imported	203	287	208	226	153	142	126	114	103	231	332
Consumption, total[c]	26,576	23,627	19,945	21,189	19,714	17,818	16,913	16,759	15,645	17,275	16,579
Northeast	4,290	3,704	3,397	3,814	3,740	3,466	3,245	3,159	3,265	3,530	3,515
Appalachian	1,860	1,796	1,614	1,767	1,684	1,501	1,444	1,490	1,442	1,498	1,420
Lake States	3,050	2,825	2,461	2,821	2,724	2,554	2,544	2,474	2,325	2,471	2,398
South	12,891	11,480	9,255	9,443	8,395	7,516	7,208	7,153	6,342	6,804	6,227
Pacific Northwest[b]	4,485	3,822	3,218	3,344	3,171	2,781	2,472	2,482	2,271	2,972	3,019
Inventories, total[d]	5,080	3,815	4,905	5,622	4,566	3,780	2,626	2,819	2,846	3,391	3,728
Northeast	1,483	1,051	1,520	1,644	1,442	1,063	869	700	820	1,119	1,218
Appalachian	367	249	332	397	372	422	206	279	280	423	439
Lake States	1,377	986	1,343	1,674	1,487	1,350	986	1,088	962	1,313	995
South	772	753	670	828	291	526	145	218	293	126	334
Pacific Northwest[b]	1,081	776	1,040	1,079	974	419	420	534	491	410	742

[a] Preliminary.
[b] Converted 600 board feet equal 1 cord.
[c] Total consumption for 1940 was 13,743,000 cords; for 1939 it was 10,816,000 cords.
[d] End of year.
Note: Detail may not add to totals because of rounding.
Sources: Prepared by Pulp, Paper and Paperboard Division, National Production Authority; data covering 1939, 1940, and 1945–51, inclusive—Bureau of the Census, U. S. Department of Commerce; data covering 1941–44, inclusive—Forest Products Bureau, War Production Board.

PULPWOOD

The record-breaking domestic production of 25,123,000 cords of pulpwood for 1951 (as indicated by domestic receipts at pulp mills), was attained as a result of regional increases in every section of the Nation. The Pacific Northwest led with an increase of 41% over 1950 domestic receipts as compared with an increase of 21% for the total United States. From an over-all standpoint, this was an outstanding achievement and a splendid example of American industry increasing production in spite of numerous hindering problems.

For the Nation as a whole no major wood production problems developed during 1951. The nearest thing to a national problem was a shortage of tractor replacement parts. In certain localities the shortage of parts definitely curtailed production. During the second quarter logging truck tires were in short supply in the Northwest because of a distribution problem which was largely corrected. Other local problems which were troublesome included shortages of labor, the price freeze, car shortage, and tightening in the supply of tractors and cranes.

WOOD PULP

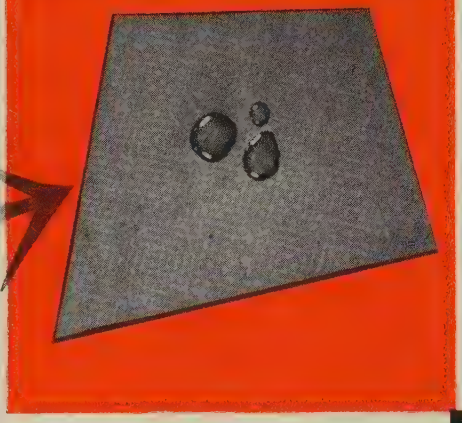
The production and consumption of wood pulp in 1951 reached an all-time high. United States production of all grades was 16,494,000 tons and consumption (including imported pulp) in paper and board and nonpaper products was 18,418,000 tons.

In spite of the large production, the supply of chemical grades, especially bleached pulps, was not adequate to meet the demand particularly during the first 6 months of the year.

The prices of imported overseas wood pulp, which were not covered by the OPS general price freeze order, rose to such an extent that the OPS on June 30, 1951, set ceilings on these pulps. Anticipating that the price ceilings would cause diversion to other markets of a substantial part of overseas pulp normally coming to the United States and, thereby,

the blotter that WON'T BLOT!

Penetration Control of Porous Surface

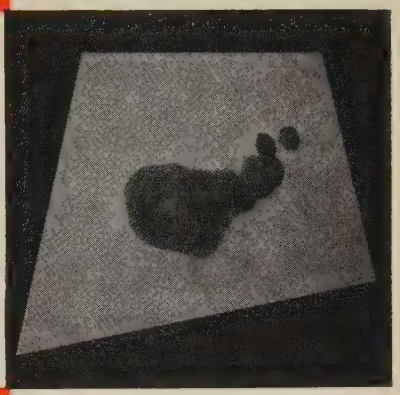


This unretouched photograph shows a 1% solution of KELSIZE twenty minutes after being puddled on blotter. Note how solution remains on surface of blotter. This test illustrates that KELSIZE is an excellent material for controlling penetration and strike through of aqueous solutions, thus increasing the efficiency of adhesive or surface sizing solutions by retaining them at the area of application.

proof THAT YOU REGULATE SURFACE DENSITY AND PENETRATION...

precisely and effectively!

Here is unretouched photograph of water, without KELSIZE, on piece of same blotter, taken seconds after water was placed on blotter. Note how water has immediately passed into blotter compared to controlled penetration of KELSIZE solution.



kelsize and kelgin

superior surface control agents

Due to their film forming properties, KELSIZE and KELGIN effectively control penetration of adhesives, starch solutions, or any water base solution.

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Table VIII. Wood Pulp—United States Annual Imports and Exports, 1940–51 (1000 Short Tons)

Item	1951[a]	1950	1949	1948	1947	1946	1945	1944	1943	1942	1940
Imports, total	2370	2385	1763	2176	2322	1805	1754	1072	1306	1237	1225
Bleached sulphite: Rayon and special chemical grades	230	239	154	235	249	202	146	133	129	134	114
Bleached sulphite: Other	347	402	331	323	288	223	242	188	231	241	239
Unbleached sulphite	563	529	392	675	732	618	657	399	519	459	373
Bleached sulphate	532	450	392	278	239	80	72	47	48	58	85
Unbleached sulphate	335	440	249	336	470	398	380	99	105	91	224
Soda	33	34	27	25	21	20	21	16	20	18	11
Chemical screenings	9	5	3	8	10	9	7	7	11	8	8
Bleached mechanical	18	20	1	....	....	1	1	[b]	....	[b]	....
Unbleached mechanical	298	260	208	291	309	249	222	177	236	220	171
Mechanical screenings	5	6	6	5	5	6	5	5	6	7	[b]
Exports, total	200	96	122	94	130	39	135	218	301	378	481
Bleached sulphite: Rayon and special chemical grades	31	28	25	18	11	8	13	11	23	29	115
Bleached sulphite: Other	44	18	20	13	44	7	17	38	45	78	102
Unbleached sulphite	44	33	39	54	54	17	27	46	90	98	72
Bleached sulphate	9	5	9	1	2	1	6	7	16	28	18
Unbleached sulphate	69	9	27	6	17	5	60	106	121	140	159
Soda	1	[b]	[b]	1	1	[b]	11	11	5	3	10
Screenings and other wood pulp	2	2	1	1	2	1	1	[b]	1	1	4

[a] Preliminary.
[b] Less than 500 tons.
Note: Detail may not add to total because of rounding.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, based upon data from the Bureau of the Census, U. S. Department of Commerce.

Table IX. Total United States Annual Wood Pulp Imports All Grades—By Major Countries of Origin (1000 Short Tons)

Country	1939	1940	1941	1945	1946	1947	1948	1949	1950	1951[a]
Total	2026	1225	1158	1754	1805	2322	2176	1763	2385	2370
Canada[b]	638	828	1145	1082	1245	1529[c]	1601[d]	1314	1717	1890
Sweden	873	279	....	672	445	555	385	266	398	257
Finland	337	93	13	....	115	224	176	149	206	182
Norway	96	17	....	....	....	10	13	29	29	35
All other	82	8	....	....	....	5[e]	2[f]	5[g]	35[h]	6

[a] Preliminary.
[b] Includes Newfoundland.
[c] Newfoundland—7854 tons.
[d] Newfoundland—7137 tons.
[e] U.S.S.R.—4928 tons.
[f] All from Austria.
[g] Austria—4459; Czechoslovakia—973.
[h] Austria—20.303; Czechoslovakia—2597; Germany—957; and U.S.S.R.—9773.
Note: Detail may not add to totals because of rounding.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, based upon data from the Bureau of the Census, U. S. Department of Commerce.

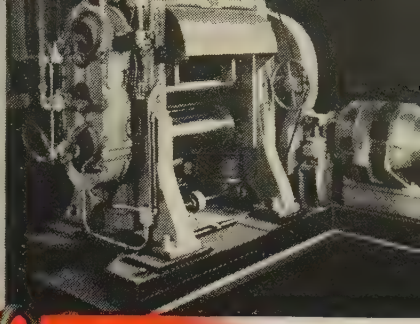
Table X. Wood Pulp—United States Annual Production and Domestic Consumption, 1939–51 (1000 Short Tons)

Item	1951[a]	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	1939
Production, total	16,494	14,808	12,172	12,872	11,946	10,607	10,167	10,108	9,680	10,783	10,375	6993
Sulphite, total	3,134	2,848	2,536	2,811	2,796	2,476	2,360	2,386	2,437	2,930	2,919	1946
Bleached	2,379	2,107	1,829	1,909	1,902	1,692	1,544	1,523	1,553	1,717	1,703	1217
Unbleached	755	741	707	902	894	784	816	863	883	1,213	1,216	729
Sulphate, total	8,576	7,502	5,977	6,014	5,357	4,588	4,472	4,549	4,236	4,738	4,527	2963
Bleached	1,879	1,418	1,118	1,040	909	750	705	665	602	653	659	424
Semibleached	315	375	264	225	193	152	149	144	147	159	164	[b]
Unbleached	6,382	5,709	4,595	4,749	4,255	3,686	3,618	3,740	3,487	3,927	3,704	2538
Soda	446	522	492	510	492	476	430	413	419	462	480	442
Groundwood	2,477	2,216	1,961	2,175	2,050	1,897	1,696	1,639	1,638	1,756	1,886	1445[c]
Defibrated, exploded, etc.	1,861	1,720	1,206	1,362	1,252	1,169	691	663	627	520	267	[c]
Semichemical												
Screenings, damaged, etc.							519	459	324	377	297	198[c]
Consumption, total	17,704	16,470	13,606	14,375	13,252	12,092	10,825	10,502	10,635	11,038	11,364	8650
Sulphite, total	3,293	3,316	3,012	3,333	3,229	3,144	2,583	2,519	2,892	3,079	3,348	2913
Bleached	2,090	2,069	1,851	1,856	1,792	1,680	1,346	1,277	1,442	1,498	1,805	[b]
Unbleached	1,203	1,247	1,161	1,477	1,437	1,465	1,237	1,242	1,449	1,581	1,543	[b]
Sulphate, total	9,298	8,379	6,677	6,663	5,860	5,141	4,680	4,588	4,430	4,633	4,614	3354
Bleached	2,354	1,844	1,484	1,305	1,068	833	756	714	683	667	696	[b]
Semibleached	351	405	277	251	199	184	168	156	163	164	208	[b]
Unbleached	6,593	6,130	4,916	5,107	4,594	4,124	3,756	3,719	3,584	3,802	3,710	[b]
Soda	493	564	526	521	520	492	440	418	456	469	515	516
Groundwood	2,753	2,483	2,184	2,482	2,328	2,133	1,905	1,830	1,855	1,926	2,219	1749[c]
Defibrated, exploded, etc.	1,867	1,728	1,207	742	1,315	1,181	684	661	639	527	346	[c]
Semichemical				149								
Screenings, damaged, etc.				485			533	486	364	404	321	119[c]

[a] Preliminary.
[b] Not available.
[c] Data on defibrated, etc. included in "groundwood" and "semichemical, of quality, screenings, and miscellaneous."
Note: Detail may not add to totals because of rounding.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, based upon data from Bureau of the Census, U. S. Department of Commerce.

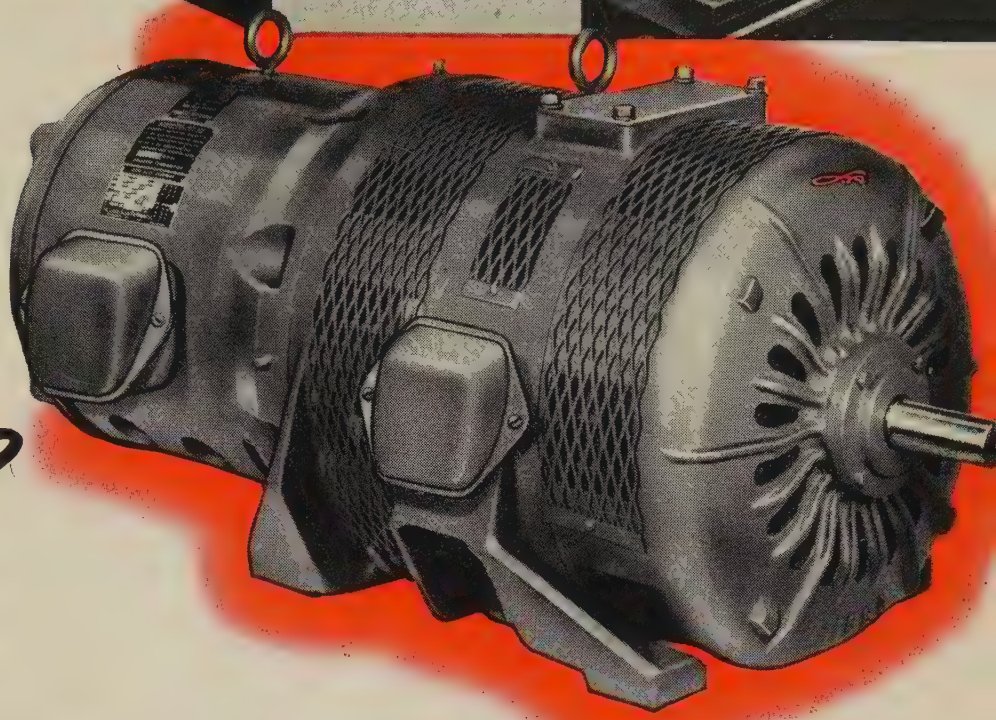
used on the slitting and rewinding line in the metal fabricating industry.

Here, Ajusto-Spede is used on special calender roll in the rubber industry.



Need stepless adjustable speeds with A.C. power?

Here's your answer



Louis Allis Ajusto-Spede

Ajusto-Spede gives you a complete, packaged A.C. adjustable speed drive — 1 to 75 HP. To help you meet your specific design needs, it provides:

1. Accurate Control! The tachometer feedback circuit maintains close regulation over the entire speed range.

2. Flexibility! Many modifications are available: Eddy current brake, for fast, smooth braking. Torque limit control for controlled acceleration and overload protection. Threading, inching or jogging, and many other special control features. Speed ranges up to 17:1 available.

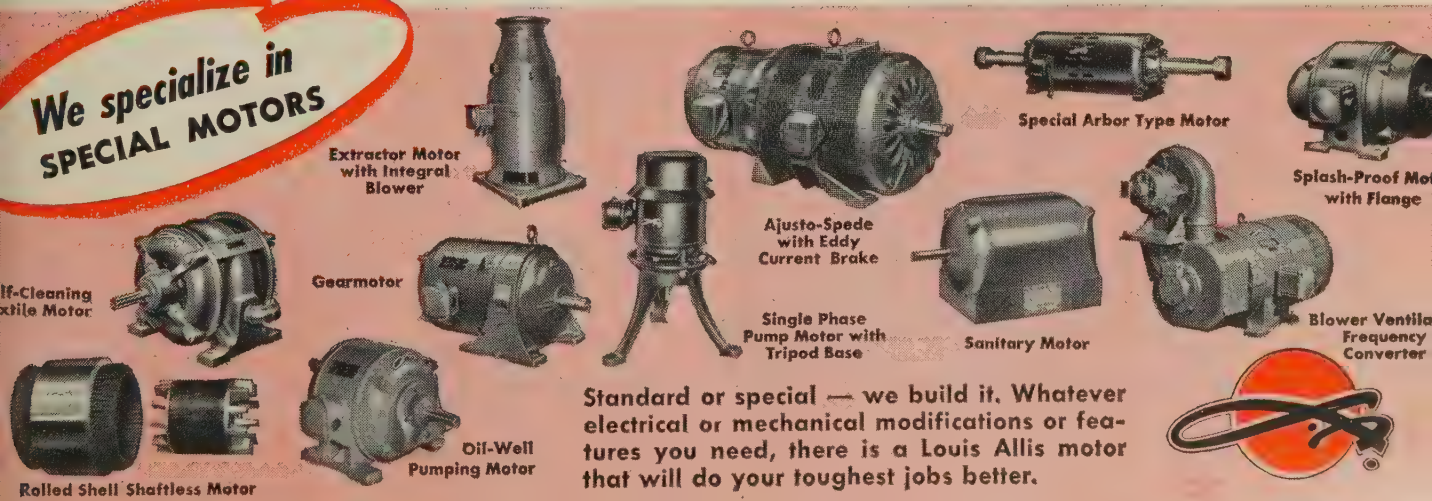
3. Compactness! Installation is simple — often the complete drive can be mounted on or inside the driven machine. Small electronic control panel and pushbutton station can be mounted at any convenient location.

Typical Ajusto-Spede applications include printing presses, extruders, mixers, ironers, calender rolls, punch presses, etc. Investigate the advantages of applying Ajusto-Spede to *your* particular problem. Write for complete information or contact the Louis Allis District Office nearest you.

AS-101

THE LOUIS ALLIS CO., *Milwaukee 7, Wisconsin*

We specialize in SPECIAL MOTORS



Standard or special — we build it. Whatever electrical or mechanical modifications or features you need, there is a Louis Allis motor that will do your toughest jobs better.

Table XI. Wood Pulp—Year-End Inventories, 1942–51

(1000 Short Tons)

Item	1951[a]	1950	1949	1948	1947	1946	1945	1944	1943	1942
Wood pulp, total	611	491	511	710	710	490	555	333	427	872
Sulphite, total	263	207	268	370	369	232	299	196	256	492
Bleached	136	100	129	157	163	107	127	152	184	287
Unbleached	127	107	139	213	206	125	173	44	72	205
Sulphate, total	231	196	147	226	244	176	179	66	67	238
Bleached	114	108	69	67	65	36	39	22	24	57
Semibleached	8	5	5	7	7	4	6	5	4	16
Unbleached	109	83	73	152	171	135	135	39	39	165
Soda	16	11	15	24	22	17	12	16	15	28
Groundwood	84	70	65	74	63	56	53	41	71	83
Miscellaneous	17	7	16	16	13	9	12	14	19	31

[a] Preliminary data for December 31, subject to revision.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, based upon data from Bureau of the Census, U. S. Department of Commerce (figures for 1945–48); Forest Products Bureau, WPB (figures for 1941–44).

Table XII. Dissolving and Special Chemical Grades of Sulphite Pulp[a] in Other than Paper and Board Manufacture,[b] 12 Months 1951

(Tons of 2000 Lb.)

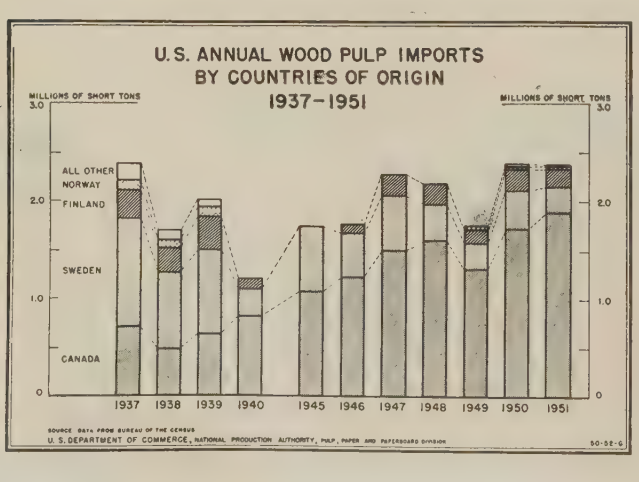
Month	Receipts			Consumption	Month-end inventories
	Total	Domestic	Imports from North America[c]		
January	58,153	34,763	23,390	56,168	53,355
February	46,291	28,402	17,889	51,310	48,336
March	61,647	41,575	20,072	56,456	53,527
April	68,192	43,517	24,675	56,991	64,728
May	54,832	37,875	16,957	56,656	62,881
June	57,990	42,540	15,450	54,591	66,280
July	64,832	41,913	22,919	64,706	75,047
August	66,191	45,468	20,723	63,765	77,589
September	58,450	38,856	19,594	63,153	72,886
October	74,190	47,434	26,756	66,941	80,141
November	64,014	45,729	18,285	61,912	83,115
December	55,927	40,366	15,561	61,191	77,831
Total, January–December	730,709	488,438	242,271	713,840	.....

[a] Includes a small quantity of most other grades of wood pulp.
[b] Data not complete. Represents all but a small percentage of the industry for the last six months and for the first six months about 88% of wood pulp consumed outside of paper and board industry; therefore, last six months' data not comparable with previous months. Includes plants classified in the following industries: "Pulp goods, pressed and molded," "Plastic materials," "Synthetic fibers," and "Explosives."
[c] Includes a small quantity of wood pulp, produced outside North America.
Source: Pulp, Paper and Paperboard Division, National Production Authority, based upon data from the Bureau of the Census, U. S. Department of Commerce.

cause supply problems in this country, NPA issued Order M-72 on July 1, 1951.

This order was designed to effect a balance between market pulp supply and demand at a slightly lower volume level than had prevailed in the first 6 months of the year. This order provided for an increase in the supply of domestic market pulp by requiring the integrated mills to reserve 3% of their chemical pulp production and offer it for sale, and at the same time required them to maintain their same rate of pulp sales as they had made during the first quarter of the year. It also limited the consumption of market pulp to 95% of 1950 and limited inventories to a 45-days' supply.

The order accomplished what it was designed for, and in spite of reduced imports, the available supply of pulp was equitably distributed and paper and board production did not suffer.



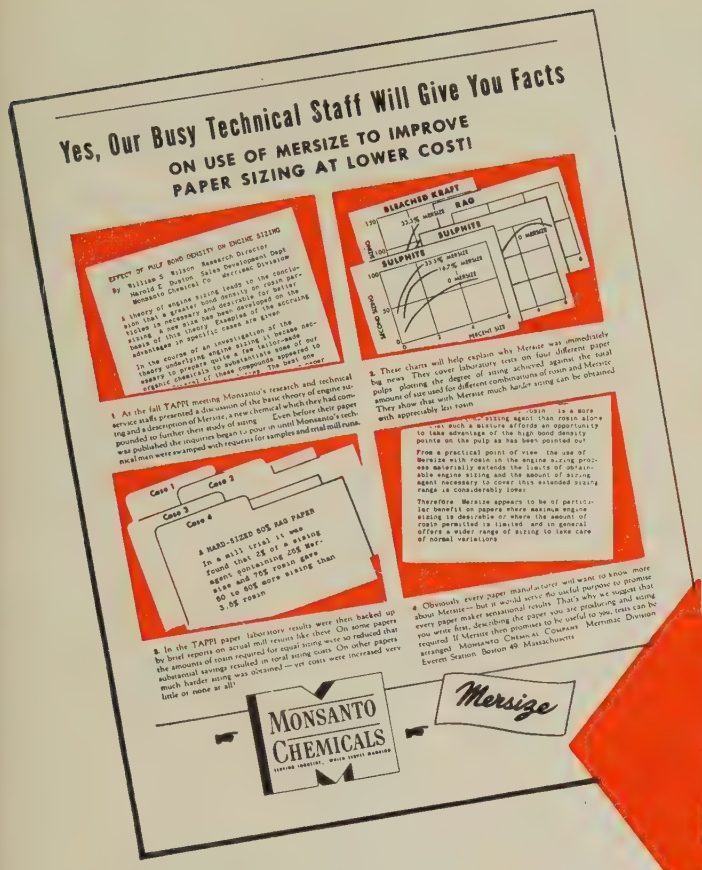
Because many Northern European ports are closed during the winter months, NPA issued a direction on Aug. 10, 1951, allowing U. S. consumers to hold up to 120 days of European pulp during this period with the provision that inventories be brought down to 45 days by June 1, 1952.

By the end of the third quarter the market for certain products manufactured from unbleached kraft began to soften with the result that an oversupply of this grade began to appear. To help correct this condition, NPA, on Dec. 29, 1951, increased the inventory allowance of unbleached kraft to 60 days. An increase in the export quota for unbleached kraft was also made effective for the 4th quarter of 1951, as well as the 1st quarter of 1952. These measures helped, but in spite of this, there continued an oversupply during the first two months of 1952. In view of these circumstances, NPA plans to further amend M-72, the details of which will likely be announced by the time this report is printed.

WASTE PAPER

During the year 1951 previous records for the conservation, salvage, processing, and consumption of wastepaper were broken by a wide margin. The greatest increase was realized during the first six months of the year.

Demands for paperboard containers from the armed forces in support of the Korean situation, as well as the high civilian requirements in support of the general civilian economy, was reflected in the needs for wastepaper. The repulping of


Yes, Our Busy Technical Staff Will Give You Facts
ON USE OF MERSIZE TO IMPROVE PAPER SIZING AT LOWER COST!
BLEACHED KRAFT
SULPHITE
MONSANTO CHEMICALS
Mersize

how many sizing dollars have you saved since 1943?

when this original MERSIZE announcement appeared

For *eight years* Monsanto research development and production facilities have worked steadily to help progressive paper manufacturers reduce sizing costs substantially—with Mersize, the *original* combination of chemically-built size and rosin.

Mersize-RM, Monsanto's latest development, does the work of *twice as much* straight rosin size—at only two-thirds the cost . . . At present prices, over 3 cents per pound of rosin size solids you may now be using—or *$30,000 annually* for the typical mill buying $100,000 of rosin size a year!

Yes, Monsanto can truthfully say "First in the Field," when it comes to chemical sizes . . . So why not benefit from Monsanto's long experience and let us tell you how Mersize can save important sizing dollars in *your* mill? MONSANTO CHEMICAL COMPANY, Merrimac Division, Boston 49, Mass.

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Table XIII. Market Wood Pulp[a]—Paper and Paperboard Mills Only—Annual Receipts, Consumption, and Inventories, 1947–51

(1000 Short Tons)

Item	1951	1950	1949	1948	1947
Wood pulp, total all grades:					
Receipts, total	2815	2911	2152	2571	2709
Domestic	1293	1213	938	1060	1189
Imported	1522	1698	1214	1511	1520
Canada and Newfoundland	1059	966	707	917	784
European	463	732	507	594	736
Consumption (purchased pulp) total	2740	2899	2325	2586	2511
Inventories (purchased pulp) total[b]	396	332	342	519	532
Domestic shipments, total[c]	1246	1140	905	1024	1041
Sulphite, all grades:					
Receipts, total	1394	1466	1209	1474	1554
Domestic	697	672	588	649	722
Imported	697	794	621	825	832
Canada and Newfoundland	498	480	370	525	492
European	199	314	251	300	340
Consumption, total	1359	1484	1313	1455	1432
Inventories, total[b]	191	163	194	297	283
Domestic shipments[c]	673	646	576	642	655
Sulphate, all grades:					
Receipts, total	940	1000	614	714	780
Domestic	394	325	187	200	260
Imported	546	675	427	514	520
Canada and Newfoundland	321	299	208	236	154
European	225	376	219	278	366
Consumption, total	912	973	666	720	730
Inventories, total[b]	141	119	102	158	188
Domestic shipments[c]	401	293	181	199	200
Groundwood and other grades:					
Receipts, total	481	445	329	383	375
Domestic	202	216	163	211	207
Imported	279	229	166	172	168
Canada and Newfoundland	240	187	129	156	138
European	39	42	37	16	30
Consumption, total	469	442	346	411	349
Inventories, total[b]	64	50	46	64	61
Domestic shipments[c]	172	201	148	183	186

[a] Market pulp consists of domestic or imported pulp purchased from a mill not under the same ownership control as the purchaser.
[b] End of year.
[c] Shipments by domestic pulp mills to domestic paper and paperboard mills. The difference between shipments and receipts may be explained in part by "in transit" pulp and probable incomplete reports on domestic shipments.
Note: Data on imports from Canada and Newfoundland also include shipments from all other North American countries, such as Mexico: data on imports from Europe also include shipments from all overseas sources.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, based upon data from Bureau of the Census, U. S. Department of Commerce. Data for 1951 preliminary.

wastepaper supports the vast output of paperboard, roofing and flooring materials, and in smaller degree certain grades of paper. In times of stress, paper and paperboard frequently substitute for scarce metals and other materials, but there is no substitute for paper and paperboard.

The salvage of wastepaper is receiving greater recognition by various organizations interested in conservation. Wastepaper, in a sense, constitutes a "secondary forest" and as such extends the utilization of the forest. In fact, during 1951, the 9 million tons of repulped wastepapers was equivalent to approximately the same number of cords of pulpwood which would have been needed for new wood pulp if the wastepaper were not utilized. On the basis of an average growth of somewhat under one-half cord of pulpwood in the forests of the south (the growth in northern states is much less), about 20 million acres of forest land would have been necessary to produce, on a sustained yield basis, the pulpwood conserved through the utilization of wastepaper. An acreage of this size equals more than 30,000 square miles or about the size of South Carolina.

PAPER

The calendar year of 1951 presented an interesting picture of contrasts insofar as the paper manufacturing industry was concerned. Changing from a state of comparative normal business practices of supply and demand during the first half of 1950 to a program designed to include requirements for the vast defense effort during 1951 necessitated stepping up paper production with existing facilities and the channeling of supplies to fill the needs of Government agencies and defense requirements.

At the beginning of 1951 production was at the peak of a gradual three-year rise, backlogs of orders were high and apparently contained many tonnage duplications, and there was inequitable distribution. At the same time, there occurred a progressive increase in demand for defense needs and most manufacturers were allocating tonnages to contract customers which left little open tonnage available on the market. The shortage of materials and replacement machinery for continued operation at accelerated tempo created many problems but for the most part production was maintained at full capacity. This was accomplished in cooperation with the Pulp, Paper and Paperboard Division of NPA, longer working weeks, and speed-up of operations. These conditions accounted for the need for regulation of distribution of paper and paper products to defense needs.

NPA Order M-36 "Government Order for paper" was issued Feb. 19, 1951, pursuant to the authority of section 101

Table XIV. Waste Fibrous Materials—United States Annual Receipts, Consumption, and Inventories

(1000 Short Tons)

Item	1951[a]	1950	1949	1948	1947	1946	1945	1944[b]	1943[b]	1939
Receipts, total	10,707	9399	7759	9120	9434	8895	8194	8359	7224	[c]
Waste paper	9,252	7964	6522	7605	7875	7487	6824	6937	6067	[c]
Rags	396	440	378	407	445	427	392	431	404	[c]
Other	1,059	995	859	1108	1114	981	978	991	753	[c]
Consumption, total	10,523	9395	7815	9036	9535	8661	8143	8244	7564	5526
Wastepaper	9,079	7956	6600	7584	8009	7278	6800	6859	6368	4366
Rags	389	442	382	416	462	403	414	428	426	468
Other	1,055	997	833	1036	1064	890	929	957	770	692
Inventories, total	1,169	966	998	1129	1087	1078	840	837	533	[c]
Wastepaper	588	387	397	517	521	515	327	315	249	[c]
Rags	60	54	56	58	67	77	53	79	71	[c]
Other	521	525	545	554	499	486	460	443	213	[c]

[a] Preliminary.
[b] 1944 receipts and inventories and data for 1943 were reported by a few mills other than paper and paperboard mills. Data for the remaining years are for paper and paperboard mills only.
[c] Not available.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority; based upon data from the Bureau of the Census, U. S. Department of Commerce, and Forest Products Bureau, War Production Board.

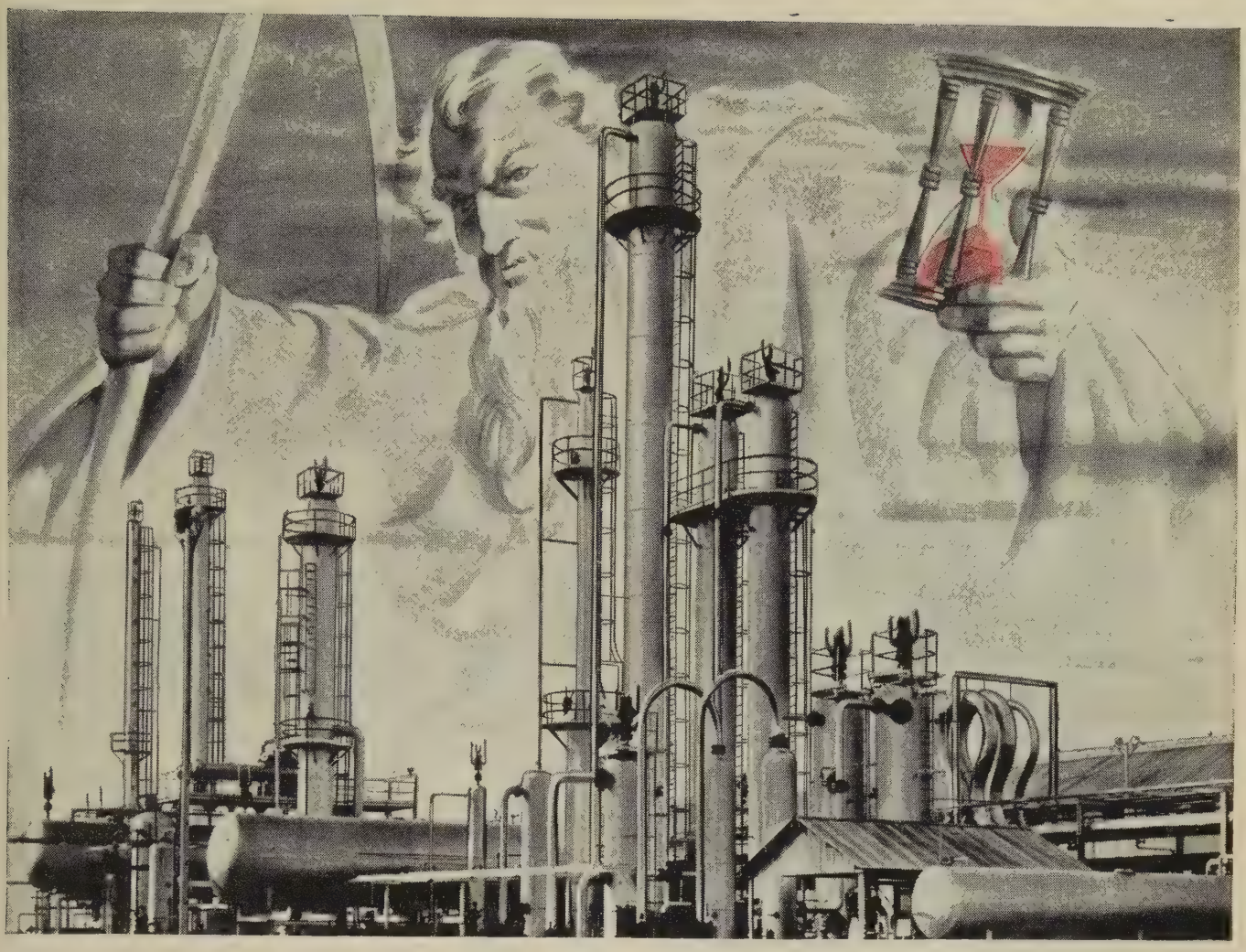

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Table XV. Paper and Paperboard—United States Production, 1939–51

(1000 Short Tons)

Type of product	1951[a]	1950	1949	1948	1947	1946	1945[b]	1944[b]	1943[b]	1942[b]	1939
All types	26,086	24,377	20,316	21,897	21,114	19,278	17,371	17,183	17,036	17,084	13,510
Paper, total	13,022	12,066	10,349	11,119	10,705	9,788	8,457	8,220	8,416	9,115	7,484
Newsprint	1,106	1,013	918	876	833	773	725	721	811	967	954
Groundwood	789	704	674	772	821	776	636	593	586	610	540
Printing	517	488	484	538	546	474	351	314	356	341	81
Converting and other	272	216	190	234	275	302	285	279	230	269	460
Machine coated paper	1,115	1,020	887	809	627	486	334	305	308	322	275
Coated one side	n.a.	68	93	54	36	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Coated two sides	n.a.	952	794	755	591	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Book paper	1,622	1,579	1,416	1,570	1,581	1,447	1,167	1,131	1,285	1,382	1,260
General printing	1,032	1,006	926	1,067	1,070	972	777	729	841	868	857
Converting	570	559	476	485	498	457	380	400	437	507	375
Other book paper	20	14	14	18	13	18	10	2	7	7	28
Fine paper	1,364	1,199	1,015	1,141	1,172	1,160	1,001	974	1,021	1,055	723
Writing paper	1,089	958	806	909	918	902	799	777	814	832	595
Cover and text	68	61	63	72	93	93	59	52	48	46	32
Bristols	107	102[c]	79	88	87	97	79	84	99	109	79
Thin paper	96	74	63	72	73	65	60	58	54	59	17
Other fine paper	4[c]	4[c]	4	.....	.....	3	3	3	5	9	[d]
Coarse paper, total	3,597	3,286	2,758	3,027	2,903	2,690	2,403	2,314	2,262	2,526	2,168
Glassine, greaseproof and vegetable parchment	175	162	141	151	156	158	140	139	144	135	75[e]
Wrapping	715	715	692	726	667	763	715	650	687	955	1,061[f]
Bag paper	846	747	690	736	540	524	365	375	518	661	654[g]
Shipping sack	829	755	510	567	671	550	423	392	315	251	[d]
Converting	1,032	907	725	847	869	695	760	758	597	526	379
Special industrial paper	419	341	248	308	289	272	238	245	208	188	71
Sanitary paper	1,215	1,148	1,008	983	894	861	824	808	806	811	357
Tissue paper	270	225	187	205	195	184	157	158	163	171	291
Absorbent paper	124	126	86	107	100	103	89	90	88	65	122
Building paper and insulation	1,401	1,425	1,151	1,321	1,289	1,036	883	881	878	1,001	659
Other paper	.....	.....	.....	.....	.....	.....	.....	.....	.....	16	64
Board, all types, total	13,064	12,311	9,967	10,778	10,409	9,490	8,914	8,963	8,620	7,969	6,025
Container board	6,347	5,830	4,680	5,079	4,944	4,315	4,131	4,228	4,008	3,755	3,361
Folding boxboard	2,429	2,369	1,943	2,024	2,257	2,317	2,092	2,116[h]	2,047[h]	1,712[h]	1,360[h]
Set-up boxboard	701	713	617	596	595	521	721	750[i]	829[i]	997[i]	865[i]
Cardboard	79	87	83	87	92	89	71	70	64	54	59
Building board	1,315	1,220	839	1,270	1,072	956	895	1,087[j]	1,064[j]	1,052[j]	115
Wet machine board	144	166	131	142	150	138	112	130	121	86	[d]
Other board	2,049	1,926	1,674	1,580	1,300	1,154[k]	891	581	408	313	265

[a] Preliminary.
[b] Comparability of the 1942–45 data with statistics for earlier years is affected to some extent by the inclusion of statistics for a few companies not previously covered and by certain classification changes. Data prior to 1942 are reasonably comparable with later years, with the exception of tissue paper, building paper and building board. (For further details see Census of Pulp Mills and of Paper and Paperboard Mills, 1942.)
[c] Estimated.
[d] Not shown separately.
[e] Includes no vegetable parchment.
[f] Includes some bag paper and special industrial paper.
[g] Includes shipping sack paper.
[h] Prior to 1945 includes all grades of bending board.
[i] Prior to 1945 includes all grades of nonbending board.
[j] Includes liner for gypsum and stock for laminated wallboard.
[k] Includes bending and nonbending board not for use in box plants.
n.a.—Not available.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, based upon data from Bureau of the Census, U. S. Department of Commerce.

Table XVI. Newsprint—United States Production, Imports, Exports, Domestic Consumption, and Inventories

(1000 Short Tons)

Item	1951[a]	1950	1949	1948	1947	1946	1945	1944	1943	1942	1939
Production	1106	1013	918	876	833	773	725	721	811	967	954
Imports	4968	4863	4639	4395	3958	3492	2669	2491	2637	2921	2615
Re-exports[b]	n.a.	n.a.	5	2	2	2	3	9	2	2	1
Exports	70	44	39	28	28	28	44	31	35	42	13
Total supply[c]	6004	5832	5513	5241	4761	4235	3347	3172	3411	3845	3555
Inventories, total[c]	461	433	457	467	386	308	273	350	378	489	341
Publishers'[d]	453	425	446	458	377	293	266	342	367	479	328
Mill	8	8	11	9	9	15	6	7	11	10	13
Change in stocks[e]	+28	−24	−10	+81	+78	+35	−77	−28	−112	+96	+8
Apparent total consumption	5925	5937	5529	5141	4753	4296	3481	3243	3627	3816	3546

[a] Preliminary.
[b] Re-exports of newsprint included in the general import statistics.
[c] Totals may not add because of rounding.
[d] Reported by 422 publishers of 525 newspapers consuming approximately 76.5% in 1950 and 1951; 77% in 1949; 78% of the newsprint consumed in 1948; 75% in 1947; 73% in 1946; 70% in the first half and 71% in second half of 1945; 72.5% in 1944; and 75% in 1943.
[e] Compared with January 1.
n.a.—Not available.
Source: Production, import, and export figures, Bureau of the Census, U. S. Department of Commerce; consumption and publishers' inventories, American Newspaper Publishers' Association; mill inventories, Newsprint Service Bureau.

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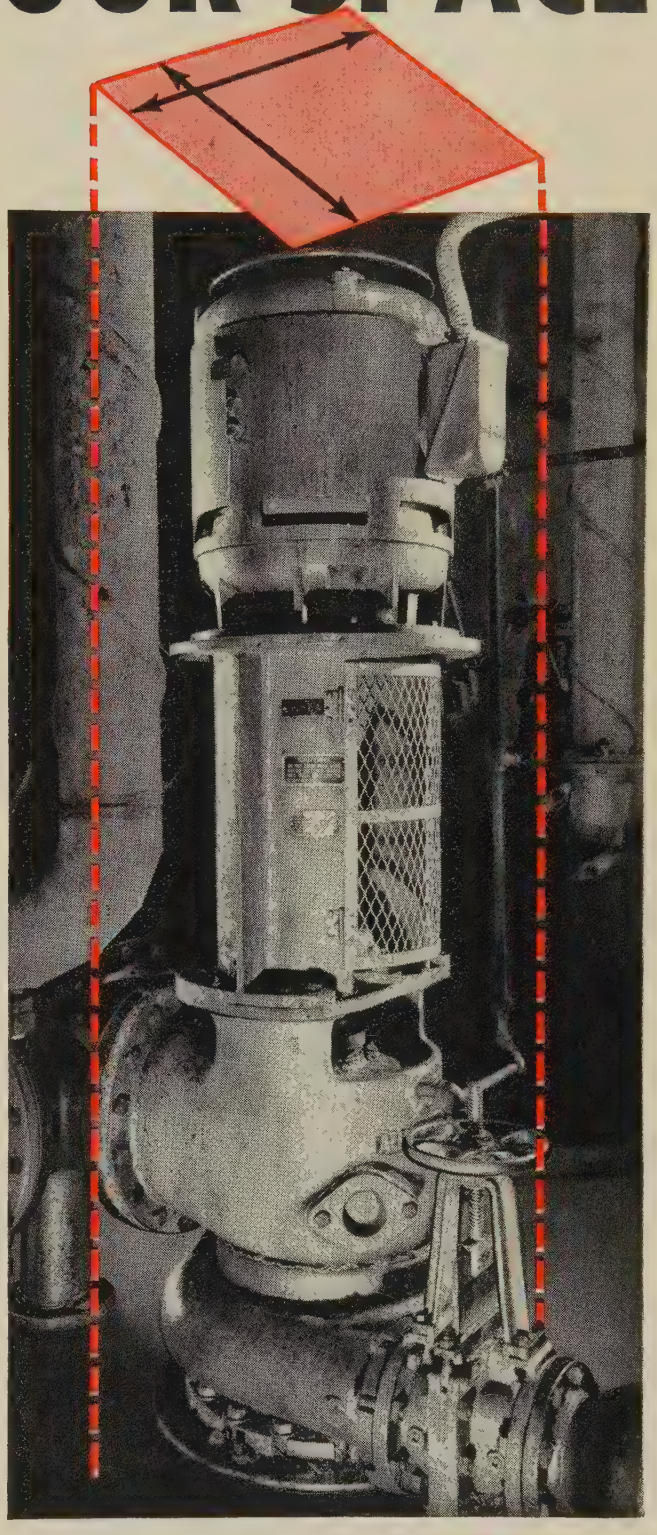

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Table XVII. Production of Newsprint in North America

(1000 Short Tons)

Year	Total[a]	United States	Canada	Newfoundland
1951[b]	6631	1106	5525[c]	[c]
1950	6292	1013	5279[c]	[c]
1949	6092	918	4732	444
1948	5859	876	4601	382
1947	5653	833	4447	373
1946	5279	773	4143	363
1945	4317	725	3259	333
1944	3985	721	2992	273
1943	4030	811	2983	236
1942	4422	967	3177	277
1941	4815	1044	3426	345
1940	4826	1056	3419	351
1939	4129	954	2869	305

[a] Details may not add to total because of rounding.
[b] Preliminary.
[c] Data for Canada include figures for Newfoundland.
Source: United States, Bureau of the Census, U. S. Department of Commerce; Canada and Newfoundland, Newsprint Association of Canada.

Table XVIII. Newsprint—United States Imports by Country of Origin

(1000 Short Tons)

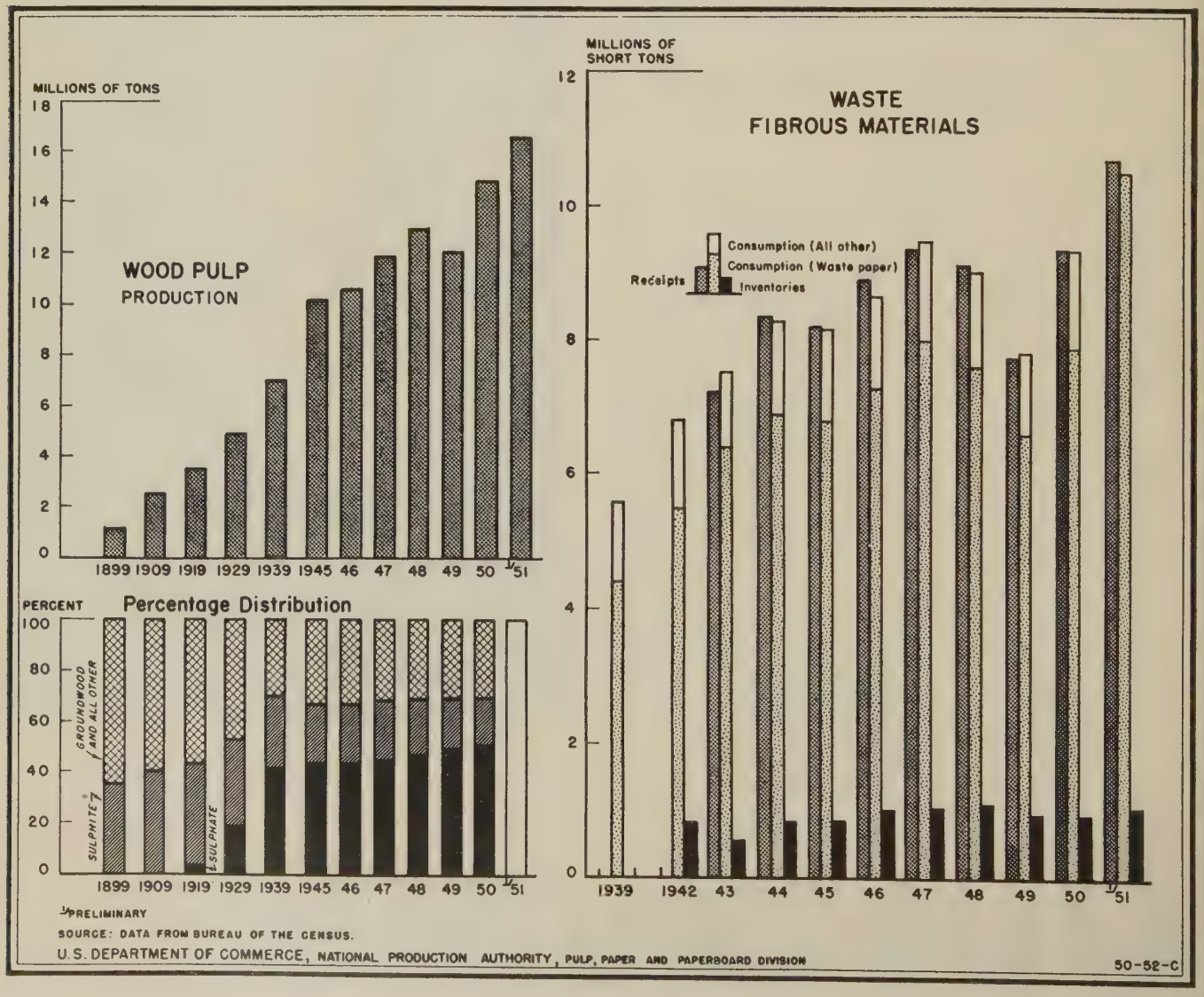
Source	1951[a]	1950	1949	1948	1947	1946
Total[b]	4968	4863	4639	4395	3958	3492
Canada[c]	4761	4690	4382	4127	3829	3478
Finland	160	144	151	132	84	12
Sweden	30	18	37	70	25	1
United Kingdom	....	[d]	35	3	....	....
Norway	9	4	30	28	6	....
France	5	2	2	28	10	....
All other countries	3	2	1	7	4	....

[a] Preliminary.
[b] Data do not necessarily add to total because of rounding.
[c] Includes Newfoundland.
[d] Less than 500 short tons.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, based upon data from the Bureau of the Census, U. S. Department of Commerce.

of the Defense Production Act of 1950, adapted in furtherance of the policy of Congress "to promote the National Defense by meeting promptly and effectively the requirements of military programs and preventing undue strains and dislocations upon production or distribution of materials for civilian use." M-36 was patterned upon the approach test in World War II under conditions of full-scale war demands, which met requirements of the military programs without undue strains or the dislocation upon production or distribution of paper for civilian use.

Under this order the average reserve set aside for the year 1951 was 8% of total production. Individual percentage set-asides were established for 13 major grades of paper and paperboard ranging from a high of 25% for crepe wadding for packing to a low of 5% for newsprint, coarse paper (other than unbleached kraft grades), sanitary tissue stock, tissue papers, absorbent papers, and special food boards. Fine rag and special industrial papers were set at 15%.

In most grades of paper the demand exceeded production during all of 1951. Actually, this situation prevailed from the last half of 1950. In the latter part of 1951 there was a



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very moderate slacking in demand and mills for the most part were able to reduce their order backlogs to more normal levels relative to production rates. It was further evident that pipe-line inventories were at least adequately, if not abundantly, filled with paper. At present new orders are approximately keeping pace with production levels and machine scheduling has returned to normal, dealer supplies and inventories are adequate, and mills are interested in new business on a competitive basis.

PAPERBOARD

The year 1951 closed with the paperboard industry largely back to, or even below, pre-Korean levels of operations in practically all significant fields of activity, in strong contrast to the boom situation prevailing during the first several months of the year. As 1951 opened, demands of manufacturers of paperboard containers and other consumers of primary paperboard were at unprecedented high levels. The paperboard industry, even operating at maximum rates and bringing in both "moth-balled" and new capacity was unable to keep up with this rate of demand. Orders and requests for positions with the mills were coming in at record levels. At the same time, the mills were producing at better than theoretical capacity rates, and backlogs of unfilled orders reached an all-time high.

The conditions which ushered in 1951 developed quickly following the opening of hostilities in Korea in mid-1950 and were the result of a combination of scare-buying, attempts of converters to build up inventories to more practical levels, accelerated defense orders, and increased industrial and commercial consumption in general.

As the second quarter of 1951 progressed, however, the pressure appeared to be over and the trend of demand turned downward. The market for fiber boxes and other paperboard containers was softening, and stocks of paperboard in box plants were reaching high levels. New orders for paperboard fell off, converters were no longer pressing for deliveries on schedule, and in many cases back orders were being cancelled. This, plus a continued high rate of production during the quarter, began to eat into order files and unfilled order backlogs started to drop. This movement was accented by the normal seasonal decline in the industry during the Summer, and later by the fact that a usually expected business pickup in the Fall and Winter failed to materialize.

Consequently, as the year went on with no reversal of the downward trend in demands, mill activity and backlogs dropped month by month, finally to reach the low point of the year by December, 1951. However, despite the relatively low levels of activity in the second half of the year compared with the first half, the paperboard industry produced more board in 1951 than in any other year, total production for 1951 running some 7% higher than in 1950, the previous record year.

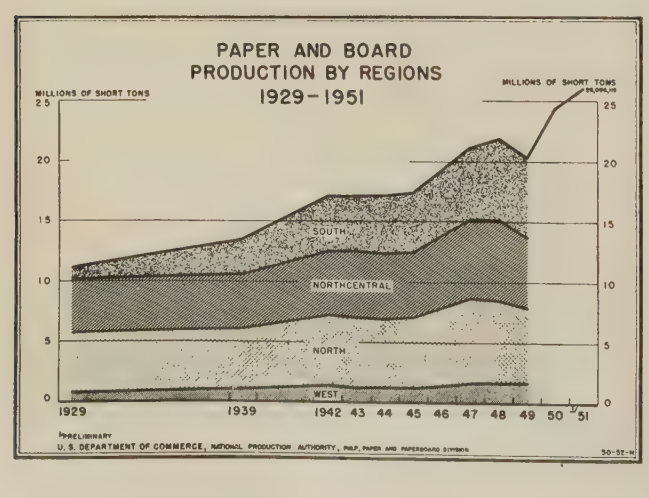

Table XIX. Monthly Value of Sales by United States Pulp, Paper, Board, and Products Manufacturers, 1946–51 (Unadjusted)

(Millions of Dollars)

Month	*1946*	*1947*	*1948*[a]	*1949*[a]	*1950*[a]	*1951*
January	337	458	504	458	478	684
February	316	449	489	432	472	655
March	351	469	532	476	541	739
April	360	482	516	438	493	710
May	375	494	500	422	530	739
June	362	474	520	432	544	696
July	341	431	456	372	493	590
August	386	479	519	462	615	692
September	364	503	521	490	585	641
October	427	547	532	506	646	710
November	424	482	498	497	643	660
December	426	496	473	463	631	582[b]
Total	4469	5764	6060	5448	6671	8098

[a] 1948–50, revised September, 1951.
[b] Preliminary.
Source: Office of Business Economics. The estimated dollar total of sales represents receipts of all operators of paper manufacturing companies. The figures include data for both corporate and noncorporate businesses, but are comparable to the sales data for corporations in statistics of income published by the Bureau of Internal Revenue.

No notable changes in conditions prevailing at the end of 1951 had appeared in the first several weeks of 1952. Apparently, accumulations of inventories, in the form of paperboard in the hands of container manufacturers and containers in the hands of container users, were still at high enough levels to preclude a change in the operating level of either container manufacturers or paperboard producers. A pickup in orders and production of paperboard would seem to await a further

Table XX. Wholesale Price Indexes—Wood Pulp, Paperboard, Paper, and Other Selected Commodities

(Index 1926 = 100)

Item	*1951*[a]	*1950*	*1949*	*1948*	*1947*
All commodities	180.4	161.5	155.0	165.1	152.1
Manufactured products	174.9	156.8	151.2	159.4	146.0
Bituminous coal	196.2	193.7	191.9	187.0	157.6
Petroleum and products	120.1	113.9	112.2	122.1	90.2
Chemicals	144.7	122.0	117.3	126.7	118.7
Wood pulp	263.2	497.1	204.5	237.8	217.0
Paperboard	220.8	163.4	150.1	170.3	171.0
Paper	177.7	155.2	153.9	153.9	138.0
Wood pulp, paperboard, and paper	198.0	163.5	160.8	168.5	155.1
Wood pulp, by grades:					
Mechanical	230.6	169.1	173.7	201.4	192.2
Soda, bleached	181.6	155.3	155.3	169.1	149.5
Wastepaper, by grades (index August 1939 = 100):					
Heavy books and magazines	487.7	288.2	179.0	229.1	346.0
Folded news	321.2	252.1	142.4	195.8	311.3
No. 1 mixed paper	326.6	220.3	n.a.	141.3	283.9
Old corrugated boxes	499.9	290.7	147.5	224.4	349.7
Paperboard, by grades:					
Chipboard, unlined (Central)	246.6	189.5	173.6	182.0	177.3
Chipboard, unlined (Eastern)	245.2	182.9	167.3	196.8	190.3
Chipboard, single manila lined (Central)	296.1	217.8	198.9	200.3	184.8
Chipboard, single manila lined (Eastern)	262.4	190.4	171.6	184.8	179.0
Kraft liners (Central)	171.7	n.a.	n.a.	n.a.	n.a.
Kraft liners (Eastern)	175.4	n.a.	n.a.	n.a.	n.a.
Corrugating (Central)	183.5	155.6	149.5	153.0	146.7
Corrugating (Eastern)	175.5	149.0	143.0	146.3	140.3
Paper, by grades:					
Book	199.0	180.2	175.0	169.7	159.8
Newsprint	154.6	140.6	139.3	136.1	123.4
Tissue	273.9	197.5	209.8	239.6	184.4
Kraft wrapping	148.3	129.1	127.6	127.6	114.8

[a] Preliminary.
Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, Department of Commerce, based upon data supplied by the Bureau of Labor Statistics, U. S. Department of Labor.

What "TYPE" Should Your Paper Be?

A GOOD PRINTER?

A WATER RESISTER?

AN EASY FOLDER?

A CURL REDUCER?

A SCUFF RESISTER?

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and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

Table XXI. United States Exports of Pulpwood, Wood Pulp, Paper, Paperboard, and Paper Products

(In Short Tons Except Where Otherwise Indicated)

Item	1939	1941	1943	1944	1945	1946	1947	1948	1949	1950	1951*
Pulpwood (in cords of 128 cu. ft.)	50,165	72,733	36,412	20,355	41,285	53,635	79,273	38,650	7,689	27,053	13,074
Wood pulp, total	139,504	328,608	300,700	218,401	135,362	39,361	130,096	93,727	122,133	95,673	199,708
Bleached sulphite: rayon and special chemical grades	48,232	34,038	22,884	10,729	13,033	8,491	10,688	17,982	25,493	27,634	31,157
Bleached sulphite: other	23,243	78,504	44,991	38,462	16,881	7,201	43,546	13,228	19,770	18,364	44,165
Unbleached sulphite	40,915	77,987	89,691	46,240	27,206	16,871	53,857	53,690	39,383	32,836	43,672
Bleached sulphate	8,285	10,474	16,344	6,697	5,633	778	2,187	716	9,542	4,709	9,488
Unbleached sulphate	14,816	118,588	120,552	105,673	60,482	4,663	17,332	6,115	27,234	9,555	78,464
Soda pulp	4,013	2,174	5,341	10,570	10,967	145	569	595	75	60	631
Screenings and other wood pulp	[f]	6,843	897	30	1,160	1,212	1,917	1,401	636	2,515	2,131
Waste fibrous materials, total	148,051	139,378	26,102	12,647	21,908	86,315	163,106	169,682	125,308	126,874	216,715
Overissue news	85,635	91,057	5,542	919	375	14,587	30,883	23,080	74,265	68,495	102,383
Rags for paper stock: Valued $50 or over per ton	6,549	2,919	1,639	1,230	862	2,755	3,506	3,220	2,846[g]	2,751[g]	2,669[a]
Rags for paper stock: Valued under $50 per ton	4,421	7,559	1,234	1,618	2,807	9,751	8,501	9,135	5,265[b]	4,422[b]	7,608[b]
Other wastepaper and paper stock	51,446	37,843	17,687	8,880	17,864	59,222	120,162	134,247	42,932	51,206	104,055
Paper, paperboard, and paper products, total	248,569	464,389	319,922	313,917	458,689	393,250	474,486	397,019	372,277	371,546	634,303
Paper and paperboard, total	197,903	399,245	254,709	253,609	396,198	304,940	352,403	295,133	294,860[c]	297,182	526,897
Paper, total	96,628	264,164	181,657	180,313	255,047	217,419	213,933	161,388	181,035[c]	175,157[d]	276,164[d]
Newsprint	13,495	70,265	35,256	31,162	43,651	27,685	27,890	27,662	38,660	43,966	70,295
Book paper, uncoated	15,387	41,406	22,415	22,022	49,277	43,837	54,290	44,442	28,230	20,123	33,851
Fine paper, total	21,115	46,430	57,907	67,741	85,671	81,021	68,302	45,317	43,656[e]	38,535[e]	47,776[e]
Writing paper	18,986	42,612	45,687	55,821	70,985	57,632	46,881	29,942	32,901	29,801	35,246
Cover paper	833	1,265	1,304	1,153	1,808	2,574	3,104	1,261	[f]	547	810
Bristols	1,296	2,553	3,866	4,057	5,099	5,693	6,051	5,197	1,034	1,071	1,409
Cigarette paper	[f]	[f]	7,050	6,710	7,779	15,122	12,266	8,917	8,327	6,580	8,790
Wrapping, bag, and converting paper, total	31,842	79,727	45,232	41,001	47,979	44,350	41,398	28,589	28,062	39,892	76,506
Greaseproof and waterproof paper[g]	4,620	9,746	17,374	17,886	18,702	13,939	13,735	8,500	3,297	3,343	5,489
Wrapping, except kraft[h]	17,608	44,137	12,628	12,280	15,986	19,846	14,109	9,164	7,113	7,486	10,225
Kraft wrapping[h]	9,614	25,844	15,230	10,835	13,291	10,565	12,554	10,925	17,652	28,563	60,792
Tissue and crepe paper[i]	6,447[j]	14,210[j]	11,776	11,170	10,257	7,207	8,428	4,927	10,029	7,433	7,294
Blotting paper	1,564	2,001	1,063	1,036	2,616	4,551	4,640	2,644	2,761	2,735	2,854
Sheathing and building paper	6,778	10,125	8,008	6,181	15,596	8,768	8,985	7,807	9,218	8,231	10,015
Paperboard, total	101,275	135,081	73,052	73,296	141,151	87,621	138,470	133,745	113,825[k]	122,025[k]	250,733[k]
Kraft container board	42,742	34,598	23,046	31,003	38,166	23,359	47,866	49,991	49,804	59,897[l]	116,018[l]
Other container and boxboard	14,055	29,311	14,652	12,266	35,703	12,857	12,011	12,445	20,201	14,987[m]	68,635[m]
Other paperboard	16,474	41,760	25,511	17,404	21,983	24,270	37,498	35,712	19,269	23,678	41,121
Fiber insulation board	19,535	14,548	7,175	7,252	25,951	17,649	27,789	18,053	18,872	15,700	20,210
Wallboard	8,469	14,864	2,668	5,371	19,348	8,886	13,307	17,544	5,679	7,763	4,749
Paper products, total[l]	50,666	65,144	65,213	60,308	62,491	88,310	122,083	101,886	77,417	74,364	107,406
Surface-coated paper	7,076	10,346	9,151	16,445	13,178	16,117	22,091	12,509	[f]	[f]	[f]
Toilet paper	5,268	8,699	9,594	6,103	5,852	7,808	7,686	7,284	8,046	7,383	9,406
Paper towels and napkins	2,980	3,026	1,840	1,650	2,018	2,078	2,042	1,908	1,867	1,972	2,736
Filing folders, index cards, and other office forms	610	788	1,328	1,304	1,349	1,469	1,756	1,934	2,636	3,772	3,699
Papeteries	140	189	48	41	185	278	411	56	366	359	407
Wallpaper	668	729	339	290	757	1,079	636	91	205	206	258
Shipping sacks	2,609	4,371	5,324	5,604	8,796	9,355	21,459	22,826	5,716	10,128	19,803
Paper bags	6,563	6,259	4,443	2,955	3,711	5,742	9,630	6,898	10,293	7,101	6,462
Shipping containers	5,404	9,323	9,236	4,966	2,878	7,765	9,548	9,030	9,822	7,795	14,867
Boxes and cartons	4,283	3,235	7,417	3,756	2,195	4,449	6,988	5,200	5,365	5,247	9,688
Envelopes	539	729	570	585	742	1,283	1,206	865	700	502	525
Cash register and adding machine paper	2,755	829	1,517	1,404	1,163	2,007	4,459	4,114	[f]	[f]	[f]
Other paper and paper products	11,771	16,621	14,406	15,205	19,667	28,880	34,171	29,171	32,401	29,899	39,555

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IN TUB AND CALENDER SIZING

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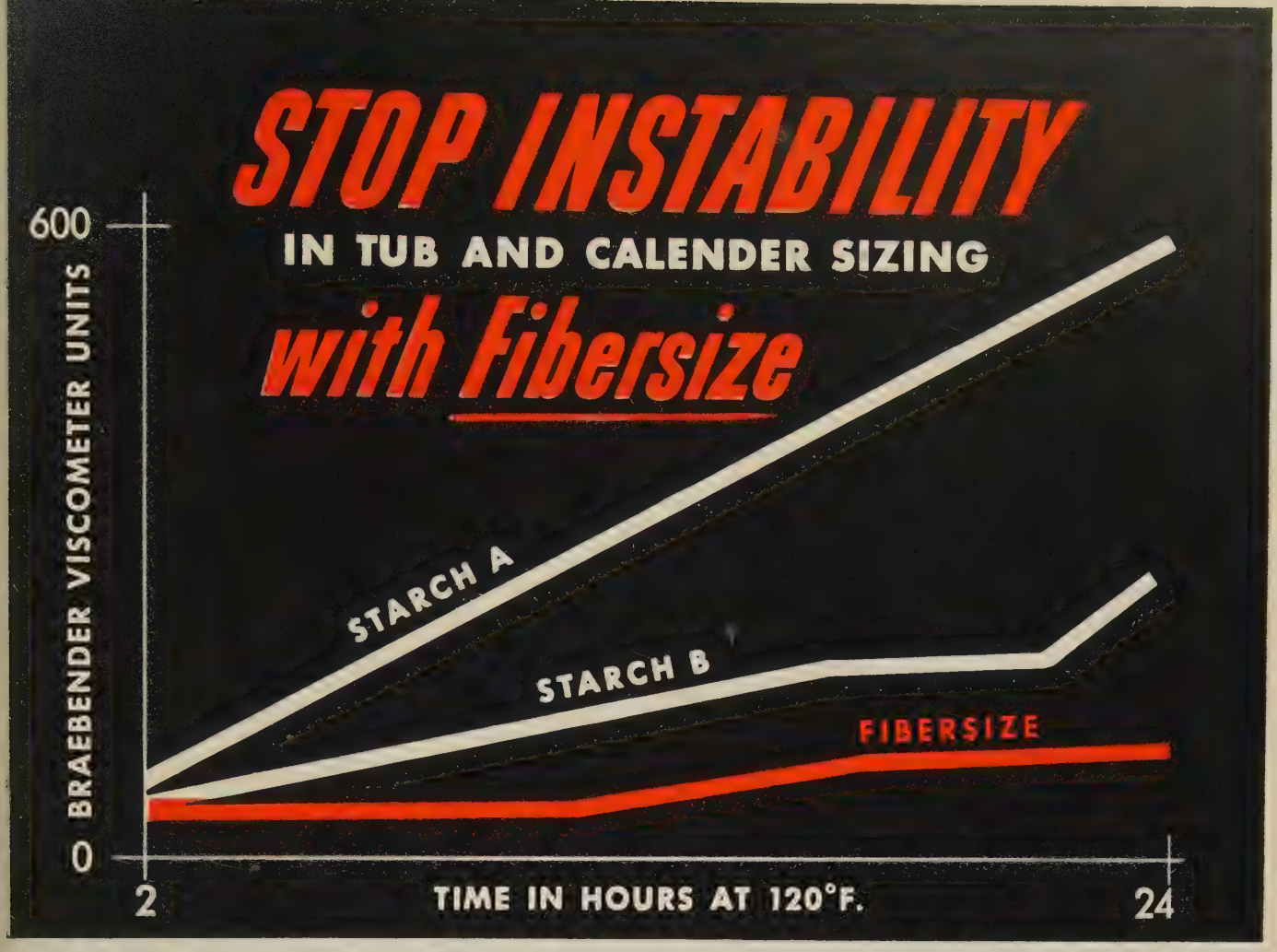

The graph tells the story of FIBERSIZE's performance—its amazing stability as compared with competitive starches.

Now, about the product . . . it's an oxidized starch that gives you *controlled penetration* in tub and calender sizing. It holds its viscosity over long periods of time. It won't become viscous and stick to rolls, causing paper to tear.

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National STARCH PRODUCTS

Note: These footnotes refer to Table XXI on page 26 A.

* Preliminary. [a] Valued at $100 or over per ton. [b] Valued at under $100 per ton. [c] Includes 7297 tons of uncoated and paper machine coated paper. [d] Includes special industrial and coated printing and converting paper. [e] Includes small quantity of miscellaneous thin paper and other fine paper not shown separately. [f] Not shown separately. [g] Includes cellophane, glassine, vegetable parchment, etc. [h] Includes bag paper and shipping sack paper. [i] Includes thin paper other than cigarette, and sanitary paper, except toilet paper. [j] Includes cigarette paper. [k] Total board including paperboard, building board, and wet machine board. [l] Includes other corrugating materials. [m] Includes bending and nonbending board.

Conversion factors derived from reported gross shipping weights: fiber insulation board—1 sq. ft. = 0.87 lb.; wallboard—1 sq. ft. = 0.65 lb.; wallpaper—1 roll = 1.04 lb.; other paper and paper products—$380 = 1 ton.

Source: Prepared by Pulp, Paper and Paperboard Division, National Production Authority, based upon data from the Bureau of the Census, U. S. Department of Commerce.

liquidation of these inventories, which in turn, ultimately requires a continuation or increase in purchases by end consumers of the goods which in turn demand paperboard containers.

CHEMICALS FOR PULP AND PAPERMAKING

While many problems and uncertainties developed in 1951 with respect to key chemicals for pulp and papermaking, sufficient supplies were made available to maintain production at full capacity levels.

The new amendment to NPA order M-69, dated Dec. 29, 1951, limited all sulphur consumers to 90% of their 1950 consumption. The Chemical Division of NPA has estimated that the average production of sulphur in 1952 will be about 5,250,000 tons. Should this production prevail, the various consumers of sulphur may be assured of no further cuts in their authorizations to use sulphur. The amount of sulphur allocated to the pulp, paper, and paperboard industry, even after the 10% cut has been applied, should adequately take care of their requirements. This has been made possible by tremendous improvements in operation and equipment developed and applied by the industry.

The fact that most kraft producers have either completely eliminated the use of elemental sulphur or drastically reduced the amount used in the production of kraft has materially increased the available supply of sulphur for other segments of the wood pulp industry. Further, there are already operating, or soon to begin operating, installations using substitute sources of sulphur in the form of pyrites, sour gas, and spent oxides, which also augment the available supply.

The chlorine problems which were faced at the beginning of 1952 seem to be, for the moment, nonexistent. Without exception, those companies that had been unable to obtain contracts for any chlorine and others who could contract only 50% or less are now being supplied at 100% of requirements. Of course, it should be pointed out that these requirements are being met on a spot basis, with very few contracts being made.

The Chemical Division of NPA expects this condition to prevail for the first quarter of 1952. However, they point

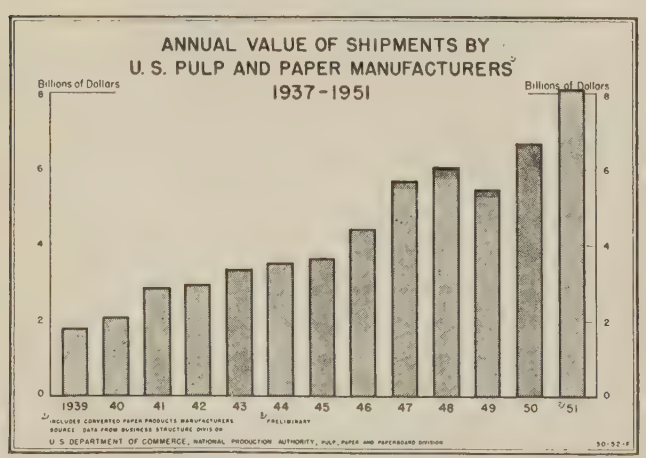

Table XXII. United States Imports of Pulpwood, Wood Pulp, Paper, Paperboard, and Paper Products

(In Short Tons, Except Where Otherwise Indicated)

Item	*1939*	*1941*	*1943*	*1944*	*1945*	*1946*	*1947*	*1948*	*1949**	*1950*	*1951**
Pulpwood, total (in cords of 128 cu. ft.)	1,130,874	1,632,605	1,391,392	1,368,109	1,562,877	1,728,262	1,828,228	2,020,979	1,418,468	1,412,365	2,497,097
Rough	237,898	133,596	337,811	458,379	726,218	891,321	936,293	913,838	510,134	373,460	876,572
Peeled	821,186	1,463,929	957,915	808,501	757,478	755,213	820,359	1,010,993	791,325	884,781	1,400,003
Rossed	27,352	1,611	23,499	14,174	2,318	169	730	806	447	151	3,931
Chipped	44,438	33,469	72,167	87,055	76,863	81,559	70,846	95,342	116,562	153,973	216,591
Wood pulp, total	2,026,441	1,157,886	1,305,549	1,071,864	1,754,065	1,805,465	2,322,460	2,176,111	1,763,102	2,384,975	2,369,566
Bleached sulphite: rayon and special chemical grades	88,052	121,130	129,379	132,675	146,032	202,192	248,606	235,481	153,946	238,846	230,321
Bleached sulphite: other	386,057	270,394	231,291	188,198	242,424	222,653	288,559	322,830	331,288	401,776	346,419
Unbleached sulphite	661,193	361,397	519,190	399,418	657,297	618,571	731,648	674,707	392,222	528,673	562,374
Bleached sulphate	103,252	59,394	47,664	47,458	71,996	79,697	239,069	277,989	391,609	450,352	532,223
Unbleached sulphate	546,167	116,224	104,678	98,557	380,432	397,906	470,174	336,449	248,814	440,378	334,673
Soda pulp	8,952	15,864	20,181	16,404	21,157	19,740	21,203	24,843	27,315	33,947	33,373
Chemical screenings	[a]	9,055	10,751	7,241	7,309	8,583	9,552	8,275	3,163	4,695	9,115
Bleached mechanical groundwood	.....	.....	.....	26	1,177	1,296	.....	.....	593	20,202	18,324
Unbleached mechanical groundwood	227,768	197,991	236,484	176,861	221,533	248,926	308,946	290,984	208,224	260,347	297,651
Mechanical groundwood screenings	[a]	6,437	5,931	5,026	4,708	5,901	4,703	4,553	5,928	5,759	5,093
Waste fibrous materials, total	116,625	106,039	62,161	68,902	75,417	66,128	80,924	102,845	72,055	131,282	110,710
Rags for paper stock	57,241	10,212	3,792	3,715	3,247	14,800	13,772	20,040	7,917	131,194	110,600
Other pulp—rag, straw, esparto, etc.	204	163	51	13	.....	200	31	4	[b]	[b]	.....
Other waste fibrous materials	59,180	95,664	58,918	65,174	72,170	51,128	67,121	82,801	64,138	88	110
Paper, paperboard, and paper products, total	2,687,484	3,123,490	2,720,618	2,576,279	2,753,210	3,625,982	4,121,400	4,581,811	4,751,323	5,007,384	5,158,010
Paper and paperboard, total	2,682,856	3,056,066	2,717,326	2,573,959	2,751,213	3,622,228	4,115,968	4,575,095	4,746,248	4,998,347	5,144,942

Table XXII. United States Imports of Pulpwood, Wood Pulp, Paper, Paperboard, and Paper Products (*Contined*)

(In Short Tons, Except Where Otherwise Indicated)

Item	*1939*	*1941*	*1943*	*1944*	*1945*	*1946*	*1847*	*1948*	*1949**	*1950*	*1951**
Paper, total	2,654,440	3,019,279	2,663,271	2,522,073	2,700,347	3,580,361	4,057,110	4,499,682	4,676,126	4,912,974	5,030,558
Newsprint	2,615,128	2,982,375	2,637,429	2,491,452	2,668,799	3,491,769	3,957,833	4,395,572	4,639,562	4,862,995	4,968,250
Printing paper, uncoated	13,408	28,474	23,329	27,246	29,655	80,046	74,401	83,379	28,281	35,278	47,326
Fine paper, total	9,798	2,710	402	432	460	532	1,579	1,537	640	1,229	1,333
Writing paper	380	128	64	102	69	46	92	120	37	115	74
Cover paper	.....	.....	10	.....	[b]	.....	.....	3	[b]	[b]	[b]
Bristols	74	2	.....	2	1	11	3	12	93	259	258
Thin paper	9,282	2,555	282	292	368	456	1,408	1,344	419	710	799
Other fine paper	62	25	46	36	22	19	76	58	91	145	202
Wrapping, bag, and converting paper, total	14,955	4,490	951	2,100	792	7,118	22,621	18,420	5,712	10,864	11,079
Greaseproof	223	4	3	6	3	40	71	33	15	622	2,113
Vegetable parchment	117	5	2	.....	.....	11	8	15	7	526	17
Kraft wrapping[c]	12,735	2,269	734	689	29	5,923	10,936	10,628	3,823	7,330	6,876
Wrapping, except kraft[c]	1,880	2,212	212	1,405	760	1,144	11,606	7,744	1,867	2,386	2,073
Tissue and crepe paper	65	107	78	43	41	21	32	376	1,352	452	223
Absorbent paper	542	287	43	54	34	16	76	92	122	101	94
Building paper	544	836	1,039	746	566	859	568	306	457	2,055	2,253
Paperboard, total	28,416	36,787	54,055	51,886	50,866	41,867	58,858	75,413	70,122	85,373	114,384
Kraft container board	10	275	2,297	475	.....	.....	.....	.....	.....	.....	967
Other container and boxboard	388	.....	1,662	1	.....	10	2,221	629	3	465	1,739
Other paperboard	12,083	12,593	20,152	20,973	21,731	13,539	23,852	44,015	47,769	54,179	78,416
Fiber insulation board	3,731	3,250	1,595	2,049	1,172	750	1,283	400	275	3,319	3,015
Wallboard	12,204	20,669	28,349	28,388	27,963	27,568	31,502	30,369	22,075	27,410	30,247
Paper products, total	4,628	67,424	3,292	2,320	1,997	3,754	5,432	6,716	5,075	9,037	13,068
Papeteries	57	4	20	3	4	36	50	38	73	155	133
Surface-coated papers	324	32	19	25	34	13	33	32	40	265	1,002
Uncoated papers, decorated or covered with a design, etc.	17	[b]	.....	.....	.....	4	5	7	1	25	103
Wallpaper	241	144	30	27	77	1,271	1,436	1,259	1,365	2,638	2,303
Decalcomania paper	464	702	328	483	536	784	922	957	619	1,110	1,277
Boxes of paper, papier-mache, or paperboard (not covered or lined)	167	104	157	425	274	352	247	300	357	479	543
Boxes of paper, papier-mache, or wood (covered or lined)	145	68	22	46	49	71	18	27	41	67	96
Manufacturers of papier-mache, n.s.p.f.	141	17	2	3	6	16	21	51	58	106	154
Manufacturers of pulp, n.s.p.f.	16	28	43	36	49	48	65	52	51	96	268
Bags and articles of surface-coated, parchment, or similar papers	133	59	58	33	10	33	77	63	56	168	181
Albums, photograph, autograph, scrap, etc.	5	2	[b]	[b]	1	2	2	3	2	6	2
Envelopes	8	5	6	15	188	99	24	40	47	47	126
Jacquard designs	[b]	[b]	[b]	[b]	[b]	.....	[b]	.....	[b]	[b]	.....
Gummed paper, n.s.p.f.	1	[b]	[b]	[b]	[b]	[a]	2	1	[b]	19	211
Tubes for holding yarn and thread	163	.....	.....	[b]	[b]	.....	[b]	.....	[b]	22	69
Wall pockets of paper, papier-mache, etc.	23	3	.....	.....	.....	4	.....	1	3	37	38
Ribbon flycatchers	273	8	117	56	106	77	103	9	.....	115	44
Masks of paper, pulp or papier-mache	48	5	[b]	[b]	.....	[a]	1	.....	6	8	31
Reinforced or cloth-lined paper	6	.....	1	.....	.....	.....	.....	.....	[b]	[b]	[b]
Stencil paper, not mounted	31	1	3	[b]	[b]	.....	[b]	1	1	2	4
Papers, n.s.p.f.	943	65,534	1,578	832	226	332	975	652	400	1,133	1,729
Manufacturers of paper, n.e.s.	1,417	708	908	336	437	612	1,451	3,223	1,955	2,539	4,754

* Preliminary. [a] Not shown separately. [b] Less than one-half short ton. [c] Includes bag paper. Conversion factors derived from reported gross shipping weights. Stereotype matrix mat or board (included under absorbent paper)—1000 sq. in. = 1.43 lb.; papeteries—$500 = 1 ton. Boxes of paper, papier- mache, or paperboard (not covered or lined)—$140 = 1 ton. Manufacturers of papier-mache, n.s.p.f.—$2240 = 1 ton. Manufacturers of pulp. n.s.p.f.—$860 = 1 ton. Albums, photograph, autograph, scrap, etc.—$3060 = 1 ton. Jacquard designs on ruled paper, etc.—$94,000 = 1 ton (price includes cost of die). Ribbon flycatchers—$840 = 1 ton. Masks of paper, pulp, etc.—$760 = 1 ton. Papers, n.s.p.f.—$80 = 1 ton. Manufacturers of paper, n.e.s.—$360 = 1 ton. Wall pockets of paper, papier-mache, etc.—10,000 wall pockets = 1 ton.

Source: Prepared by Pulp, Paper and Board Division, National Production Authority, based upon data from the Bureau of the Census, U. S. Department of Commerce.

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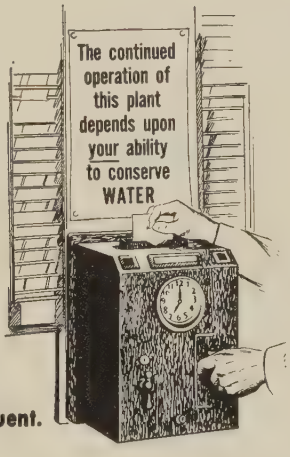

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out that they expect a tightening up in the available chlorine supply for the remainder of the year.

The chlorine expansion goals which were expected to come in 1952 have been set back to the first quarter of 1953 due to the lack of copper and nickel. If this expansion were to come in as predicted, the supply and demand would have been in balance by the last quarter of 1952.

The new NPA order on sulphuric acid, M-94, dated Dec. 29, 1951, has effectively corrected the shortage of sulphuric acid in our industry with respect to production of alum.

LABOR

The labor supply in the pulpwood cutting operations and the pulp and paper industry for 1951, embracing all the requirements in types of manpower and skills peculiar to the combined operations of the paper industry, was adequate for full operation of all existing facilities.

On May 1, 1951, or thereabout, the woodland operators expressed considerable concern over their inability to draw experienced wood cutters who had been laid off back in their operations. The wage freeze was reported responsible for this. The Woodland Operators Association in the Northeastern region, which draws a major portion of its manpower from nearby Canada, submitted a proposal to increase their wage rates to the WSB in May, 1951. The Pulp and Paper Division of NPA, feeling that there would be a delay in getting pulpwood deliveries to mills turning out essential pulp and paper products in the defense program, lent its assistance in getting the wage increase proposal approved by the WSB. The immediate labor shortage in pulpwood operations was overcome at this point.

A gradual shrinkage in the supply of woods labor from Canada is in evidence. However, this is being countered by the use of more power saws and other power equipment, thus increasing the yield per man employed.

FOREIGN TRADE

United States foreign trade in pulp and paper during 1951 was highlighted by a 100% jump over 1950 in exports of wood pulp. The nearly 200,000 tons of pulp exported represented the largest annual total since the last full year of war—1944. Nearly half of the 1951 shipments went to Europe with the United Kingdom and Germany each taking around 17% of the grand total. Latin America received 22% of the aggregate and Canada about 21%. The greatest proportionate gain was in unbleached sulphate, 1951 exports of which were 7 times the 1950 total.

Imports of wood pulp in 1951 were moderately below the previous year, the net decline being due largely to a drop of 140,000 tons in receipts from Sweden. This decline was more than counterbalanced by a rise of 170,000 tons in pulp receipts from Canada plus one of 7000 in receipts from Norway. Imports of Finnish pulp, on the other hand, were down 23,000 tons as compared with the year before. The largest gain was made in bleached kraft (18%) while unbleached kraft (lately in good supply in the United States) was 24% lower, in a comparison of the two years.

Imports of pulpwood climbed precipitously in 1951 to a total of nearly 2.5 million cords—a gain in excess of 77% over the year before. This upsurge permitted an increase of nearly 1.2 million cords in country-wide mill inventories of pulpwood, in addition to supporting an 11% gain in the domestic output of wood pulp.

In the paper field, an 1951 increase of more than 100,000 tons of newsprint was noteworthy. Exports of 70,000 tons in 1951—59% higher than the year previous—reflected the acute world demand for this essential grade as well as United States participation in the efforts of the International Materials Conference to relieve newsprint emergencies.

Reprinted from Pulp, Paper and Board Industry Report—Annual Review, Vol. VIII, No. 1 (March, 1952) issued by the National Production Authority, U. S. Department of Commerce, Washington, D. C.

Human papermakers learned well from the wasp

As early as 1719, the celebrated naturalist, René Réamur reported the manner in which the wasp made paper from wood . . . where man used only rags and linen. Observing the world's first professional papermaker in action, Réamur learned that the wasp chews wood fibers, mixes them with a natural size and spreads this paste to dry into a paper substance for its nest.

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Symposium on Corrugated Starch Adhesive—*Moderator:* Burt Mendlin, Cornell Paperboard Products Co., Milwaukee, Wis.

Symposium on Corrugated Silicate Adhesive—*Moderator:* R. L. Kreyling, Philadelphia Quartz Co., Philadelphia, Pa.

Starch Formulations and Control of Starch Viscosity

J. E. KILLINGER

Starches and amylaceous products of different types and kinds have been used since 1936 to produce a very large percentage of all corrugated board made in the United States. If my information is correct, it appears the use of starch as a corrugating adhesive is becoming more general in other countries. Possibly, one deterring factor in curtailing more universal usage is closely associated with the strong demand in foreign countries for starches used in food channels.

Basically, the use of starch as an adhesive in the corrugated board industry involves the application of an ungelatinized or raw starch to the flutes and gelatinizing or pasting the starch by means of heat. Raw or ungelatinized starch would settle out of the water suspension, and a carrier or bodying agent is therefore necessary to keep the starch in suspension. Certain chemicals are added to improve the adhesiveness of the starch or to prevent its re-solution when the finished board becomes wet.

CARRIER PART

As stated above, one function of the carrier is to prevent settling of the raw or pasting starch. A far more important function of the carrier is to assure holding sufficient water in the glue line to satisfy the hydration or pasting of the raw starch. One other important function of the carrier is to control the body or relative viscosity of the adhesive.

RAW OR PASTING PART

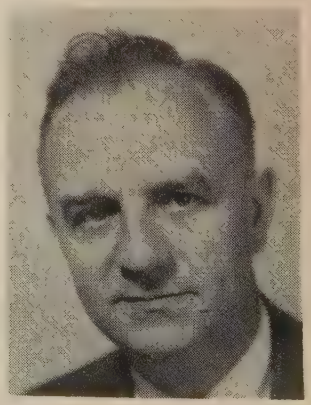
The principal adhesive in a corrugating starch formulation is the raw starch portion. From a theoretical and economical standpoint, pearl corn or unmodified cereal or root starches would be the logical choice for the raw portion. Actual experience with these types of starches has confirmed them to be the best from both economical and operational viewpoints. If the starch industry was to set up specifications for the best type of starch for the raw portion, it would probably agree on a set of specifications somewhat as follows: low cost, ready availability, high viscosity, and uniform reactivity with chemicals such as caustic, borax, urea-formaldehyde, ketone, and resorcinol resins. In order to visualize just what happens when the raw starch portion becomes an adhesive, let us consider briefly the change which takes place as the starch gelatinizes. Starch when heated in the presence of water hydrates and, in so doing, a decided increase in relative viscosity takes place; furthermore, as this pasted starch cools or loses some water to the board components, the viscous adhesive becomes very stiff and rubbery in nature. Certain chemicals such as borax increase greatly the relative viscosity. This rapid change produces what may be termed the green or preliminary adhesive bond. It follows, therefore, that any starch or starch-bearing material which exhibits fluid suspension and extremely high relative viscosity after gelatinizing should produce a satisfactory corrugating adhesive. This great and rapid increase in relative viscosity from the suspension to the paste is, however, not the only operational factor which must be considered. Starches or starchy materials which paste in the presence of glue aids such as borax and caustic soda at room or slightly higher temperatures cannot obviously be used because of the excess heat around the glue pans on the single facer.

GLUE AIDS FOR NONWATERPROOF CORRUGATING STARCH ADHESIVE

Certain boron compounds, principally borax or similar boron derivatives, react chemically with starch after it has been pasted and not only increase relative viscosity tremendously but also increase the adhesive and cohesive properties. The maximum effective percentage of borax with pearl cornstarch appears to be about 3 to 4% based on the entire starch solids. Usages above this amount, in the author's estimation, do not contribute any advantage. Some of the root starches and certain cornstarch derivatives are extremely reactive with borax and usages of less than 3 to 4% produce the maximum beneficial results.

Caustic soda is employed in the starch process chiefly for the purpose of lowering the temperature to which any starch suspension must be heated to paste or gelatinize. With cornstarches, it is customary to use $2^3/_4$ to 3% of caustic to effect a gelatinization temperature of 140 to 145°F. Root starches require considerably less caustic and one must be very careful or gelatinization will take place in the single-face pans.

Burt Mendlin, Cornell Paperboard Products Co.



J. E. Killinger, Penick & Ford Ltd.

J. E. Killinger, Penick & Ford Ltd., Cedar Rapids, Iowa.

* Presented at the 37th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 19, 1952.

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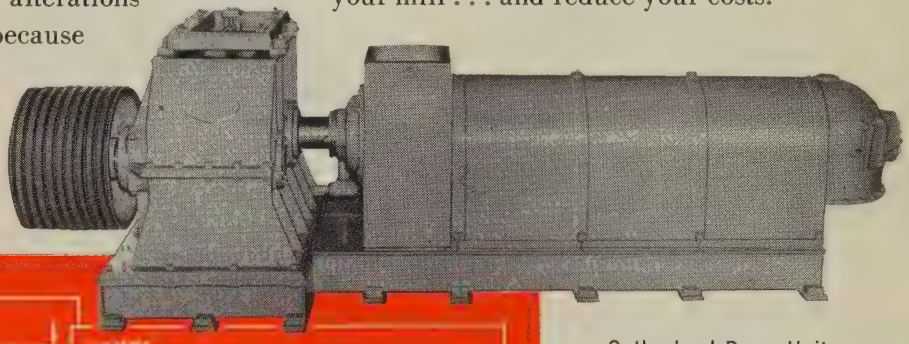

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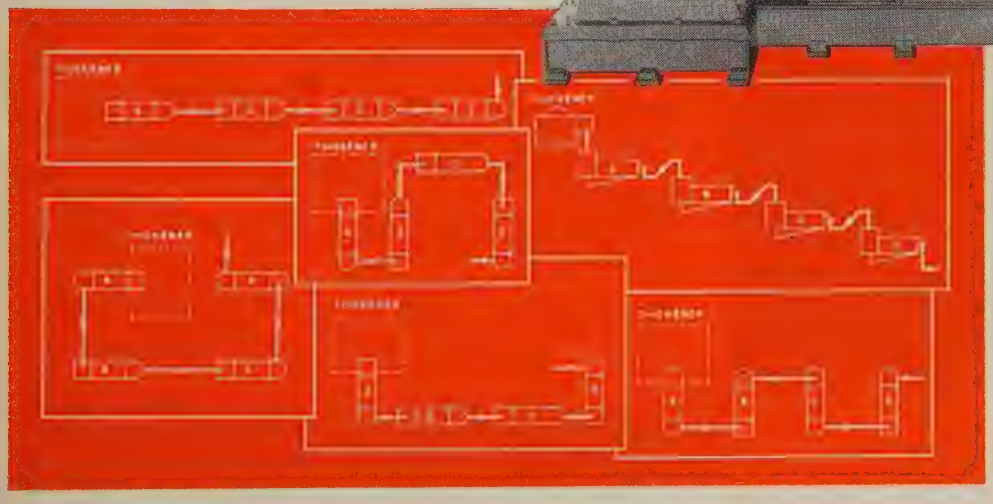

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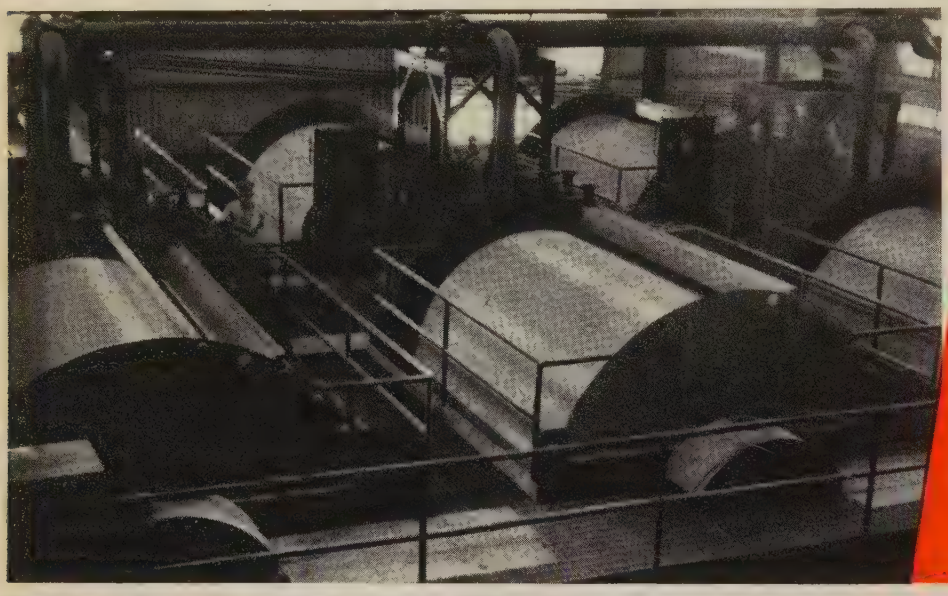
RATIO OF CARRIER TO RAW STARCH

Keeping in mind the function of the carrier is to hold water in the glue line and prevent settling of the raw starch, it becomes apparent that the optimum ratio would be one involving the smallest amount of carrier which will satisfy these requirements. It is entirely possible by formulation or choice of carrier to employ a ratio of 1 part carrier to as high or higher than 10 or 12 parts of raw starch. From experience, it has been found a ratio of about 1 to 6 for pearl cornstarch is best. With the converted or lower molecular weight starch carriers, it is necessary to use a ratio of 1 to 4 or even lower. Both types of carrier are currently being employed successfully. The water-holding capacity of fully hydrated pearl cornstarch is definitely greater than that of the thinner boiling starches. Consequently, the lower percentage of starch used in the carrier assures a higher percentage of the total starch is present as the principal adhesive.

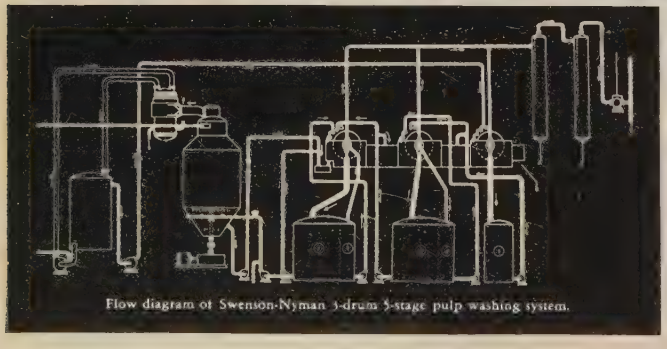
Before leaving the subject of carrier and raw starch ratio, the author would like to comment on one other very important variable which has received far too little attention in carrier starch preparation. A starch which has high water-absorbing or hydrating capacity is very often cooked or gelatinized with an insufficient amount of water to completely satisfy its hydrating capacity. In order to demonstrate the difference this will make in body, water holding, and adhesive value, one has to but cook a 20% concentration of a highly hydrated starch and then dilute it with cold water to 10%. If this diluted paste be compared with the same starch which was cooked in 10% concentration, it will be noted that the diluted paste has a much lower body, and microscopic examination shows a large number of the starch granules have not completely pasted. The diluted paste upon standing for a short time will usually show some settling of these partially swollen starch granules. In a great many plants, the primary starch mixer is too small to allow for the most complete hydration of the carrier starch with the result that low relative viscosity and, more seriously, one which is easily reduced in body results. It is felt preparation of the carrier in the larger secondary tank produces with all types of carriers currently used the most stable carrier. And, as indicated above, this one variable probably has more effect on relative viscosity stabilization than any difference between the types of carrier starches employed.

STARCH FORMULATIONS

A considerable number of starch formulas or variations are



PULP IS WASHED CLEANER with Swenson-Nyman Equipment



Flow diagram of Swenson-Nyman 3-drum 5-stage pulp washing system.

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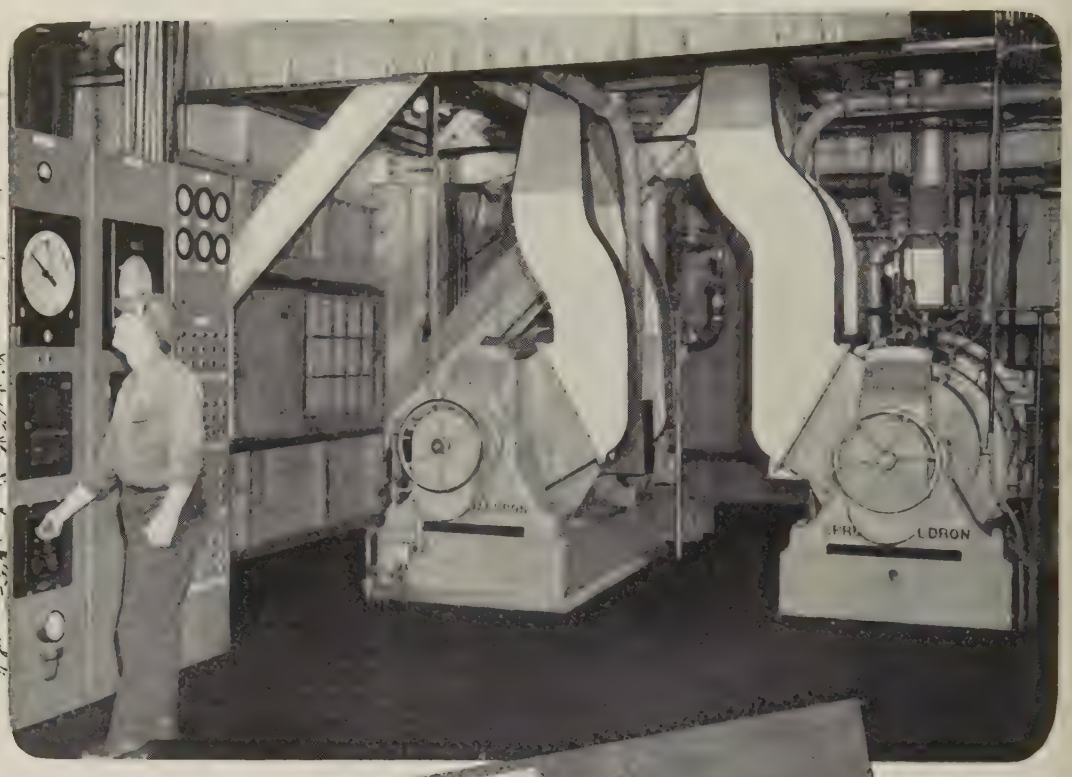

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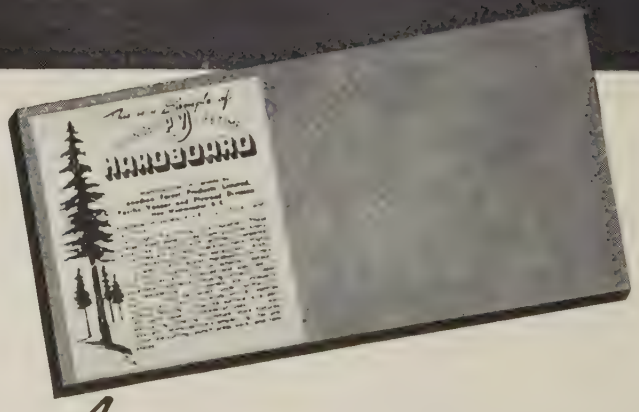

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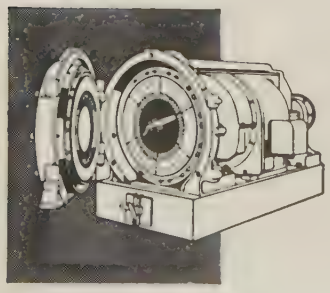

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employed today to produce both regular and waterproof corrugating starch adhesive. For this discussion, the variations may be grouped into two general classes, i.e., differences in type of preparation equipment and differences in formulation and products used.

Difference in Type of Preparation Equipment

All of the corrugating starch prepared today is made either in one single tank or by means of a primary and secondary tank. Each type has some advantages and disadvantages with reference to each other. The two-tank process has some advantage over the single tank in that the raw starch portion may be creamed or suspended in a relatively small amount of the total water employed. This, if insufficient agitation be obtained or if the type of starch is difficult to wet out, may save some time in preparation. With the two-tank process, one also has opportunity to add the nonstarch ingredients separately to both portions of the adhesive. In most all the two-tank equipment, the carrier is prepared in the small primary tank and this, as previously stated, is usually too small to allow the carrier part to develop its full strength. The primary tank is also usually too small to accommodate all of the raw starch part in one charging. Multiple charging of the primary tank with raw starch suspension is not too desirable because all of us know the final body of corrugating starch varies with the rate at which the raw or carrier part is mixed with the other part.

The single U-shaped tank process allows for easy charging with the dry starch, since it is usually located near the floor level. It allows for use of all the water necessary to develop full carrier strength. Both cooking and any necessary cooling may be easily accomplished. The disadvantages with the single tank are the difficulty of effecting rapid raw starch dispersion into the carrier. The excellent agitation in the U-tank does disperse starch effectively except when the tank is almost full. This may be very easily corrected by supplying supplementary agitation to force the dry starch through the carrier. A slow-moving spiral agitator may be installed in the flat portion of the U-tank which effectively overcomes the difficulty. The only objection to the one-tank process is that it may, under some special conditions, be necessary to provide a small chemical treating tank.

Difference in Formulation and Products Used

From the graphs which your committee has presented and which summarize quite effectively the recent survey made, it is apparent a great many modifications of the basic process are in operation. The time allotted is far too short to discuss all these variations. The author has attempted up to now to discuss generally some of the more important or significant properties necessary for good operation. Perhaps, a brief statement of what constitutes a good corrugating adhesive with an appended formula for all the known processes will suffice.

A concise and comprehensive definition of a regular or waterproof corrugating starch adhesive is most difficult. Basically, however, we may state that the best starch adhesive should be readily available at a fair price and one which holds in the glue line the necessary water to satisfy the raw starch requirements. It must not increase or decrease excessively in body before application to the board and should exhibit the highest possible increase in relative viscosity after being applied and heated to the lowest safe temperature on the machine.

Appended to this paper are typical plant formulas used for regular or waterproof corrugating starch adhesive and these data cover the following types of starch adhesives:

1. Corrugating starch made with one starch product in one-tank process.
2. Corrugating starch made with one starch product in two-tank process.
3. Corrugating starch made with modified cornstarch carrier in one-tank process.
4. Corrugating starch made with modified cornstarch carrier in two-tank process.
5. High concentration corrugating starch.
6. Low concentration corrugating starch.
7. Regular nonwaterproof corrugating starch prepared with acid pH.
8. Corrugating starch prepared with unbalanced borax and caustic ratio.
9. Corrugating starch prepared with starch other than corn.
10. Corrugating starch made with addition of alginate.
11. Waterproof corrugating starch made with urea-formaldehyde resin and an ammoniacal catalyst.
12. Waterproof corrugating starch made with urea-formaldehyde resin and high concentration of alum.
13. Waterproof corrugating starch employing urea-formaldehyde resin according to reacted starch process.
14. Waterproof corrugating starch using alkaline formula with ketone resin.
15. Waterproof corrugating starch with urea-formaldehyde resin and polyvinyl alcohol bearing adhesives of acid pH.
16. Waterproof corrugating starch using Uformite No. 700 with acid catalyst.
17. Waterproof corrugating starch using Uformite No. 700 with alkaline catalyst (two types).
18. Chemically stabilized corrugating starch (nonwaterproof).
19. Chemically stabilized waterproof corrugating starch.

CONTROL OF STARCH VISCOSITY

When a fluid flows or when its form is altered, forces are called into play within the fluid which offer resistance to the force causing flow or change of form. This property of the fluid is known as viscosity and a liquid is referred to as mobile or viscous, according to its tendency to flow readily or not. Absolute viscosity is based on a true fluid whereas starch pastes may exhibit physical properties resulting from true solutions, systems exhibiting plastic flow, gels, and suspensions. Thus, when we refer to viscosity of a starch solution, we are really talking about something which does not exist.

The body or relative viscosity of an adhesive, regardless of whether it be starch, glue, asphalt, or silicate of soda, does have a definite effect on the operation of a corrugator. Some manufacturers insist on a very heavy body; others, on a medium or low relative viscosity Fortunately or perhaps unfortunately, not all corrugating machines have similar adhesive applying mechanisms and from a practical standpoint you should employ the "viscosity" which operates best on your particular machine.

Once this value has been determined by actual test runs, it is quite important that the relative viscosity of the adhesive be maintained in as narrow a range as possible. Before leaving the subject of relative viscosity range or level, it might be stated that any level which will insure constant pickup and transfer of an adhesive which holds the water in the glue line until the raw starch pastes, is a satisfactory level at which to operate. Generally speaking (but not always the case), the higher relative viscosities will better assure keeping the water in the glue line until it is used by the starch. Variation in body of corrugating starch adhesive can and often does occur. In numerous cases, the fault is not with the starch as supplied but with the operation. Some of the most common causes of so-called extreme variations in body which have actually happened many times might be summarized as follows:

1. Viscosity values on the brass-type tube are compared directly with the glass viscosimeter. Both types are quite reliable but they do not check each other.

2. A paste man complained to his boss that a new car of starch was too thin and a service call revealed he had taken the viscosimeter apart for cleaning it and then not only inserted the glass tube upside down but also polished the base plate containing the very carefully standardized orifice on a high-speed buffing wheel.

3. It is not at all uncommon to find the orifice crusted with either dried adhesive or hard water scale.

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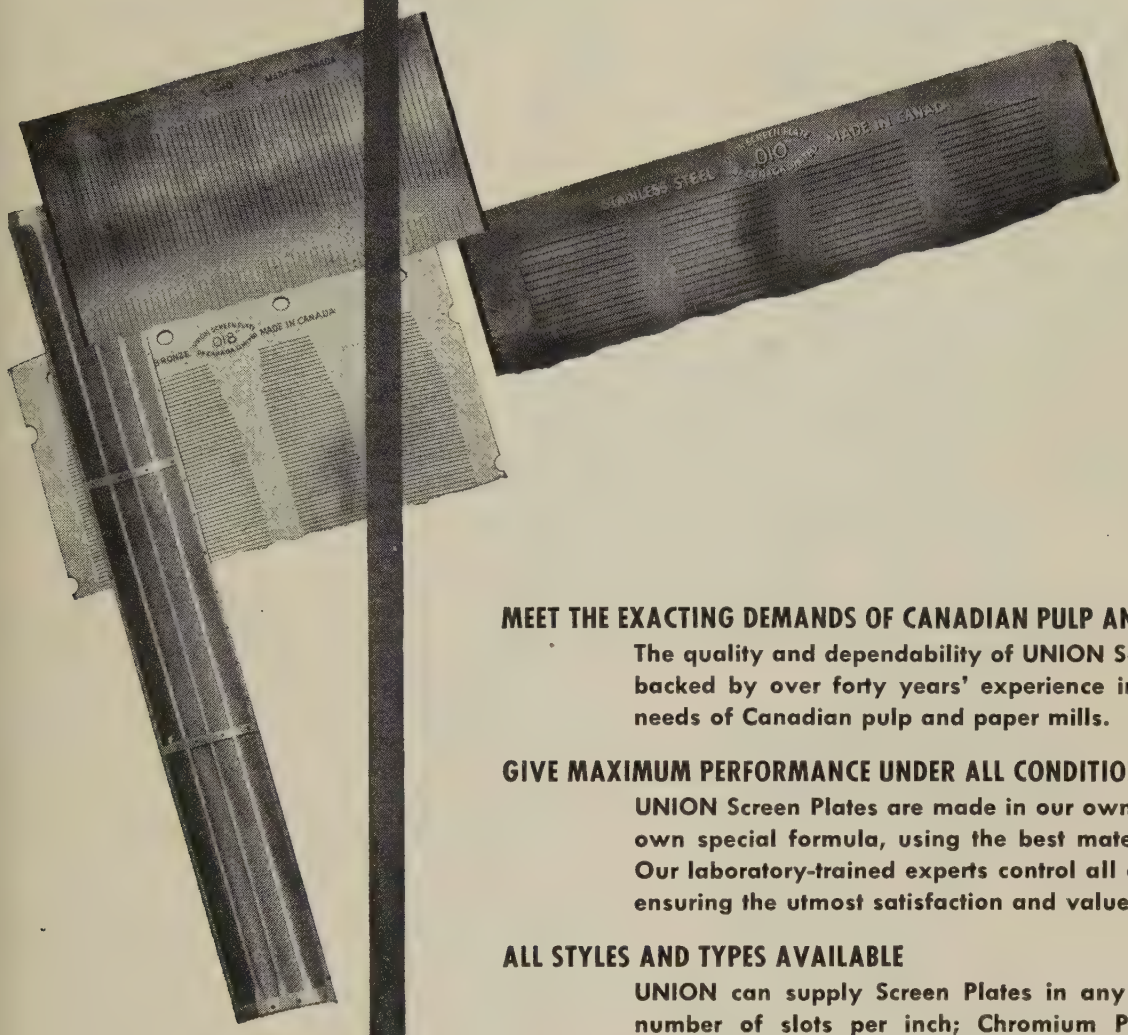

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4. The rate and temperature at which the carrier and raw portion are mixed can cause very large differences in relative viscosity. If the carrier which usually contains the caustic soda necessary to lower the gelatinization temperature of the finished adhesive is too hot or added too rapidly to the raw starch portion, this caustic soda may and often does cause the raw portion to swell, sometimes far enough to produce a very pasty or semi-plastic mass. Likewise, if the raw starch be added dry as in the one-tank process, good efficient agitation is necessary to prevent swelling due to high local concentration of the raw starch and caustic soda.

5. To insure best possible results with any formula, care should be exercised to see that all ingredients including water be measured or weighed accurately.

6. Caustic soda is very hygroscopic and the cover on the caustic drum should be replaced immediately after weighing this chemical. Caustic is one ingredient of corrugating starch which must be weighed accurately and, if for example, 30 pounds are used in a batch, one may actually be adding only 20 pounds or less due to the large amount of moisture the flake caustic has absorbed from the air.

7. The time and temperature at which the carrier is heated has a very pronounced effect on the final viscosity of corrugating starch. Long time and high temperature may reduce the viscosity from a normal batch of, say, 35 seconds to water value of 19 to 20 seconds.

8. The temperature at which a relative viscosity of starch is determined is important. Corrugating starch adhesive may vary from temperatures just above freezing to over 125°F. In order to show graphically the difference in relative viscosity caused by temperature, large samples were taken from the storage tank of two different types of regular borated corrugating starch. These samples were placed immediately in a water bath at 125°F. and "viscosity" values determined at different temperature levels between 80 and 120°F. Both starch samples were made with the same starch, caustic, and borax content. The only difference in these samples was the presence of a very small amount of algin in sample 1. There is not too much difference in relative viscosity between temperatures of 100 and 120°F. but there is an appreciable difference between 100 and 80°F. The sample containing algin showed a loss in "viscosity" of $8^1/_2$ seconds between 100 and 120°F. and an increase of 31.6 seconds between 80 and 100°F. The sample without algin showed much less change due to temperature differences, the values being a loss of 1.8 seconds between 100 and 120°F. and an increase of 10 seconds between 80 and 100°F.

Alginates and other strongly, hydrophilic colloids are frequently used in corrugating starch formulations and many manufacturers have satisfied themselves that improved operations do result. Most all strongly hydrophilic colloids undergo a very pronounced change in viscosity with changes in temperature. This leads one to wonder if the improved operations possible with this class of additives might not be more logically related to water-holding capacity than to any stabilization of corrugating starch body.

An article on corrugating starch "viscosity" appeared recently in one of the journals in which a specially mill converted starch carrier was compared with regular pearl cornstarch, the inference being that the adhesive made with the converted carrier is more stable to mechanical breakdown. The data, however, which were presented failed to take into account the change in relative viscosity brought about by differences in temperature. In one case, the relative viscosity was determined for the test period at 103°F. and in the other case the temperature varied from 86 to 95°F. If one makes the obvious temperature corrections and then compares the two different starch formulations, there is really not any significant difference in relative viscosity.

There may be some advantage in the specially prepared carriers. The point which is being stressed is that we too often lose sight of the importance of constant temperature when drawing comparisons in regard to relative viscosities. Some of the newer hydroxy alkyl ether derivatives of starch, in addition to showing excellent water-holding properties and being extremely reactive with resins, also produce corrugating starch solutions which are more resistant to loss in relative viscosity when circulated over the machine.

9. Pumping the adhesive against pressure or variable pressure will cause a variation in relative viscosity. Where excessive distances exist between the starch storage tank and the machine, it is good practice to employ a small constant level supply tank at the machine.

10. Microbiological growth in the adhesive is responsible at times for lowering relative viscosity. Most microbiological growth in starch is accompanied with a distinct fermentation or decomposition odor; however, there are some types of microorganisms which liquefy starch with little or no odor. It is good practice to use an effective preservative periodically.

11. The starch manufacturer or supplier can and sometimes does slip up and deliver starch which might not be up to 100% par. Starch as extracted from any source does vary somewhat due to variations in climatic or growing conditions. Drying of starch at extremely high temperatures may produce a product which is not the best for the corrugated board manufacturer. The manufacturer realizes these and other possible variables and has at his disposal standardizing tests to assure delivery of the most desirable grade.

From personal experience and observations, there does not seem to be much, if any significant difference in the resistance to loss of "viscosity" between the cornstarches used as carriers today. Some of the root starches, particularly potato, do seem to lose body much faster than the more resistant cereal starches.

If, despite the precautions and remedial measures discussed above, one is troubled with objectionable variations in relative viscosity, there remain both mechanical and chemical solutions to the problem. A constant recording viscosimeter, such as manufactured by the Norcross Co. of Newton, Mass., might be coupled with electrically motorized switches to start a high-speed agitator for reducing "viscosity" or to start a pump for delivering to the storage tank some high "viscosity" starch from a separate storage tank. This type of equipment not only assures a permanent record of the starch operations but holds the body of the adhesive within the desired operating range.

A most effective chemical stabilization of corrugating starch body suitable to meet the most adverse pumping conditions was discussed by the author last year at the February TAPPI meeting. This process involves condensing a small amount of resin with the carrier starch before cooking and was published both in the April, 1951, issue of *Tappi* and by *Fibre Containers* in April, 1951. A condensation of the formulas suggested for both regular and waterproof types of starch is appended with the other formulas previously referred to in this paper.

APPENDIX

1. Corrugating Starch Made with One Starch Product in One-Tank Process

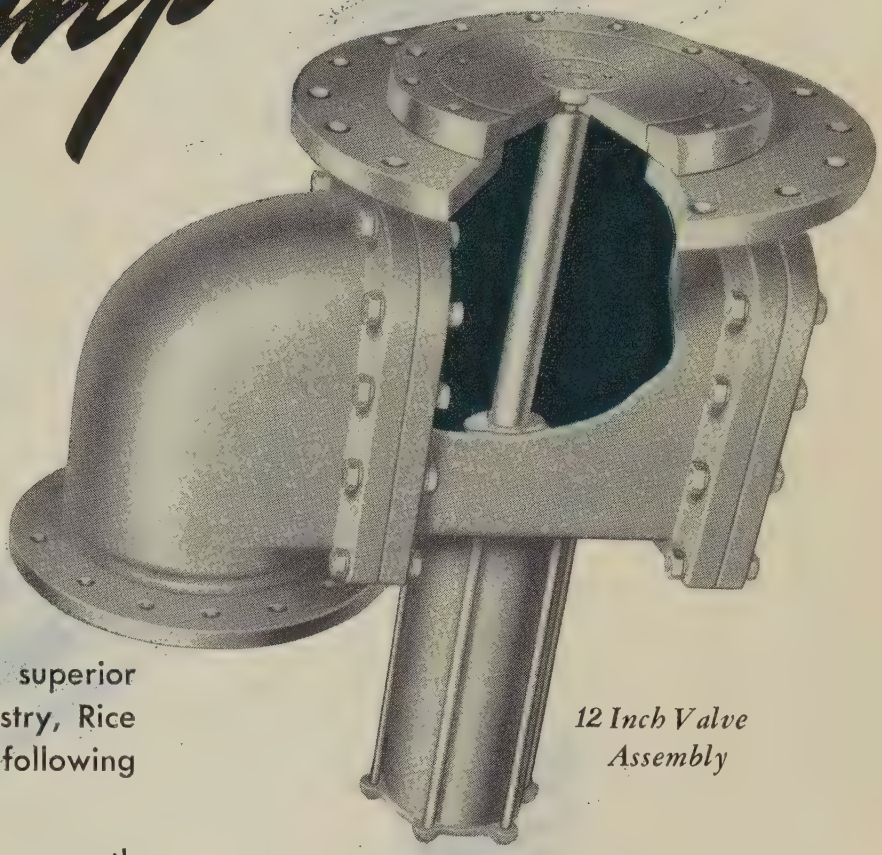
1.	Add 210 gallons water to tank, lb.	1749
2.	Add pearl cornstarch, lb.	170
3.	Heat to 140°F.	
4.	Add caustic solution	
	(a) 10 gallons water, lb.	83
	(b) Caustic, lb.	33
5.	Heat to 160°F. (total condensate), lb.	133
6.	Hold for 10–15 minutes	
7.	Add 372 gallons cooling water, lb.	3099
8.	Add borax, lb.	33
9.	Add pearl cornstarch, lb.	1030
10.	Mix thoroughly	
	Total adhesive, lb.	6330
	Total solids,	1266
	Per cent solids	20
	Gel temperature	142–145°F.

2. Corrugating Starch Made with One Starch Product in Two-Tank Process

Primary Mixer:		
1.	Add water, lb.	756
2.	Add pearl cornstarch, lb.	170
3.	Heat to 140°F.	
4.	Add caustic solution	
	(a) Water, lb.	83
	(b) Caustic, lb.	33
5.	Heat to 160°F. (total condensate), lb.	95
6.	Hold 10–15 minutes	
7.	Cooling water, lb.	600
Secondary Mixer:		
1.	Water, lb.	3530
2.	Pearl cornstarch, lb.	1030
3.	Borax, lb.	33
4.	Drop contents of primary mixer slowly	
5.	Mix thoroughly	
	Total adhesive, lb.	6330
	Total solids, lb.	1266
	Per cent solids	20

RICE BARTON

Dump Valves



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Trim of bronze or stainless steel.

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3. Corrugating Starch Made with Modified Cornstarch Carrier in One-Tank Process

1. Water, lb.	1749
2. Modified cornstarch (2), lb.	225
3. Heat to 140°F.	
4. Caustic solution	
(a) Water, lb.	83
(b) Caustic, lb.	31
5. Heat to 160°F., condensate, lb.	140
6. Hold 15 minutes	
7. Water, lb.	2776
8. Borax, lb.	31
9. Starch, lb.	900
10. Mix thoroughly	
Total adhesive, lb.	5935
Total solids, lb.	1187
Per cent solids	20

4. Corrugating Starch Made with Modified Cornstarch Carrier in Two-Tank Process

Primary Mixer:	
1. Water, 120 gallons, lb.	1000
2. Modified cornstarch (3), lb.	214
3. Caustic solution	
(a) Water, lb.	83
(b) Caustic, lb.	32
4. Mix 15 minutes	
5. Water, 110 gallons, lb.	916
6. Mix 5 minutes	
Secondary Mixer:	
1. Water, 365 gallons, lb.	3040
2. Borax, lb.	34
3. Pearl cornstarch, lb.	956
4. Drop contents of primary mixer slowly	
Total adhesive, lb.	6275
Total solids, lb.	1236
Per cent solids	19.7

5. High Concentration Corrugating Starch

Primary Mixer:	
1. Water, lb.	756
2. Pearl cornstarch, lb.	140
3. Heat to 140°F.	
4. Caustic solution	
(a) Water, lb.	83
(b) Caustic, lb.	30
5. Heat to 160°F., total condensate, lb.	95
6. Hold for 15 minutes	
7. Water, lb.	600
Secondary Mixer:	
1. Water, lb.	2246
2. Pearl cornstarch, lb.	1060
3. Borax, lb.	30
4. Drop contents of primary mixer slowly	
5. Mix thoroughly	
Total adhesive, lb.	5040
Total solids, lb.	1260
Per cent solids	25

6. Low Concentration Corrugating Starch

1. Water, lb.	1749
2. Pearl cornstarch, lb.	150
3. Heat to 140°F., lb.	90
4. Caustic solution	
(a) 10 Gallons water, lb.	83
(b) Caustic, lb.	25
5. Mix 5 minutes	
6. Water, lb.	3590
7. Borax, lb.	25
8. Pearl cornstarch, lb.	850
9. Mix thoroughly	
Total adhesive, lb.	6562
Total solids, lb.	1050
Per cent solids	16

7. Regular Nonwaterproof Corrugating Starch Prepared with Acid pH

1. Water, lb.	2083
2. Pearl cornstarch, lb.	200
3. Heat to 190°F. (condensate), lb.	251
4. Hold for 10 minutes	
5. Water, lb.	1749
6. Cool to 140°F. or below	
7. Pearl cornstarch or modified cornstarch (4), lb.	1400
Total adhesive, lb.	5683
Total solids, lb.	1600
Per cent solids	28.1

8. Corrugating Starch Prepared with the Unbalanced Borax and Caustic Ratio

1. Water, lb.	1749
2. Pearl cornstarch, lb.	200
3. Heat to 140°F.	
4. Caustic solution	
(a) Water, lb.	83
(b) Caustic, lb.	33
5. Heat to 160°F. (total condensate), lb.	135
6. Hold for 10–15 minutes	
7. Water, lb.	2997
8. Borax, lb.	8
9. Pearl cornstarch, lb.	1000
10. Mix thoroughly	
Total adhesive, lb.	6205
Total solids, lb.	1241
Per cent solids	20

9. Corrugating Starch Prepared with Starch Other than Corn

Primary Mixer:	
1. Water, lb.	665
2. Pearl cornstarch, lb	175
3. Caustic solution	
(a) Water, lb.	42
(b) Caustic, lb.	10
4. Heat to 180°F., condensate, %	90
5. Water, lb.	750
Secondary Mixer:	
1. Water, lb.	3165
2. Borax, lb.	33
3. Starch (5), lb.	900
4. Drop contents of primary mixer slowly	
5. Mix thoroughly	
Total adhesive, lb.	5830
Total solids, lb.	1118
Per cent solids	19.1

10. Corrugating Starch Made with Addition of Alginate

1. Water, lb.	1749
2. Alginate, lb.	9
3. Pearl cornstarch, lb.	150
4. Heat to 140°F.	
5. Caustic solution	
(a) Water, lb.	83
(b) Caustic, lb.	30
6. Heat to 160°F. (total condensate), lb.	130
7. Hold for 10–15 minutes	
8. Water, lb.	3021
9. Borax, lb.	30
10. Pearl cornstarch, lb.	950
11. Mix thoroughly	
Total adhesive, lb.	6152
Total solids, lb.	1169
Per cent solids	19

11. Waterproof Corrugating Starch Made with a Urea-Formaldehyde Resin and an Ammoniacal Catalyst

Carrier Portion:	
1. Water, lb.	584
2. Converted cornstarch (6), lb.	200
3. Heat to 185°, hold 15 minutes, condensate, lb.	85
4. Water, lb.	292
Raw Starch Portion:	
1. Water, lb.	876
2. Pearl cornstarch, lb	800
Resin Portion:	
1. Water, lb.	192
2. Resin, lb.	250

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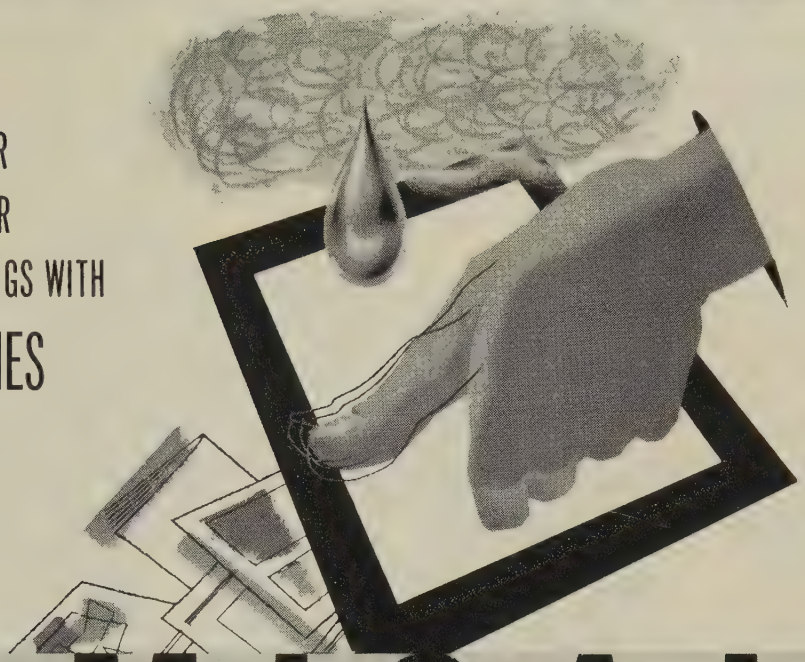

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Ammonium Chloride Solution:	
1. Water, lb.	45
2. Ammonium chloride, lb.	45
Total adhesive, lb.	3379
Total solids, lb.	1295
Per cent solids	38.4

12. Waterproof Corrugating Starch Made with Urea-Formaldehyde Resin and High Concentration of Alum

Primary Tank:	
1. Water, lb.	1200
2. Caustic solution	
(a) Water, lb.	17
(b) Caustic, lb.	2
3. Pearl cornstarch, lb.	200
4. Heat to 165°F., condensate, lb.	142
5. Hold for 15 minutes	
Secondary Tank:	
1. Water, lb.	2729
2. Resin, lb.	80
3. Pearl cornstarch, lb.	1332
4. Alum, lb.	160
5. Drop contents of primary mixer slowly	
Total adhesive, lb.	4301
Total solids, lb.	1774
Per cent solids	30.3

13. Waterproof Corrugating Starch Employing Urea-Formaldehyde Resin According to the Reacted Starch Process, U. S. Pat. 2,450,377

1. Water, lb.	2080
2. Pearl cornstarch, lb.	250
3. Resin, lb.	75
4. Heat to 190°F., condensate, lb.	266
5. Alum, lb.	20
6. Hold 5–10 minutes	
7. Water, lb.	1725
8. Pearl cornstarch, lb.	1250
9. Mix thoroughly	
Total adhesive, lb.	5666
Total solids, lb.	1595
Per cent solids	28.2

14. Waterproof Corrugating Starch Using Alkaline Formula with Ketonic Resin

Use same formulas as in Nos. 1, 2, 3, and 4. Add 5% resin (starch basis) slowly after completion of batch. Ketonic resins raise gelatinization temperatures about 5°F. It is therefore necessary to add additional caustic to obtain standard gelatinization temperature.

15. Waterproof Corrugating Starch with Urea-Formaldehyde Resin and Polyvinyl Alcohol Bearing Adhesives at Acid pH

1. Water, lb.	2499
2. Du Pont, No. 77 adhesive, lb.	100
3. Pearl cornstarch, lb.	200
4. Resin, lb.	60
5. Heat to 190°F., condensate, lb.	303
6. Alum, lb.	20
7. Hold 5–10 minutes	
8. Water, lb.	1250
9. Cool to 140°F. or lower	
10. Pearl cornstarch, lb.	1000
Total adhesive, lb.	5432
Total solids, lb.	1380
Per cent solids	25.4

16. Waterproof Corrugating Starch Using Uformite 700 with Acid Catalyst

1. Water, lb.	2082
2. Pearl cornstarch, lb.	200
3. Heat to 190°F., condensate, lb.	251
4. Hold 10 minutes	
5. Water, lb.	1500
6. Cool 140°F. or below	
7. Pearl cornstarch, lb.	1200
8. Alum, lb.	60
9. Uformite No. 700, lb.	180
Total adhesive, lb.	5473
Total solids, lb.	1514
Per cent solids	27.7

17. Waterproof Corrugating Starch Using Uformite 700 with Alkaline Catalyst (2 Types)

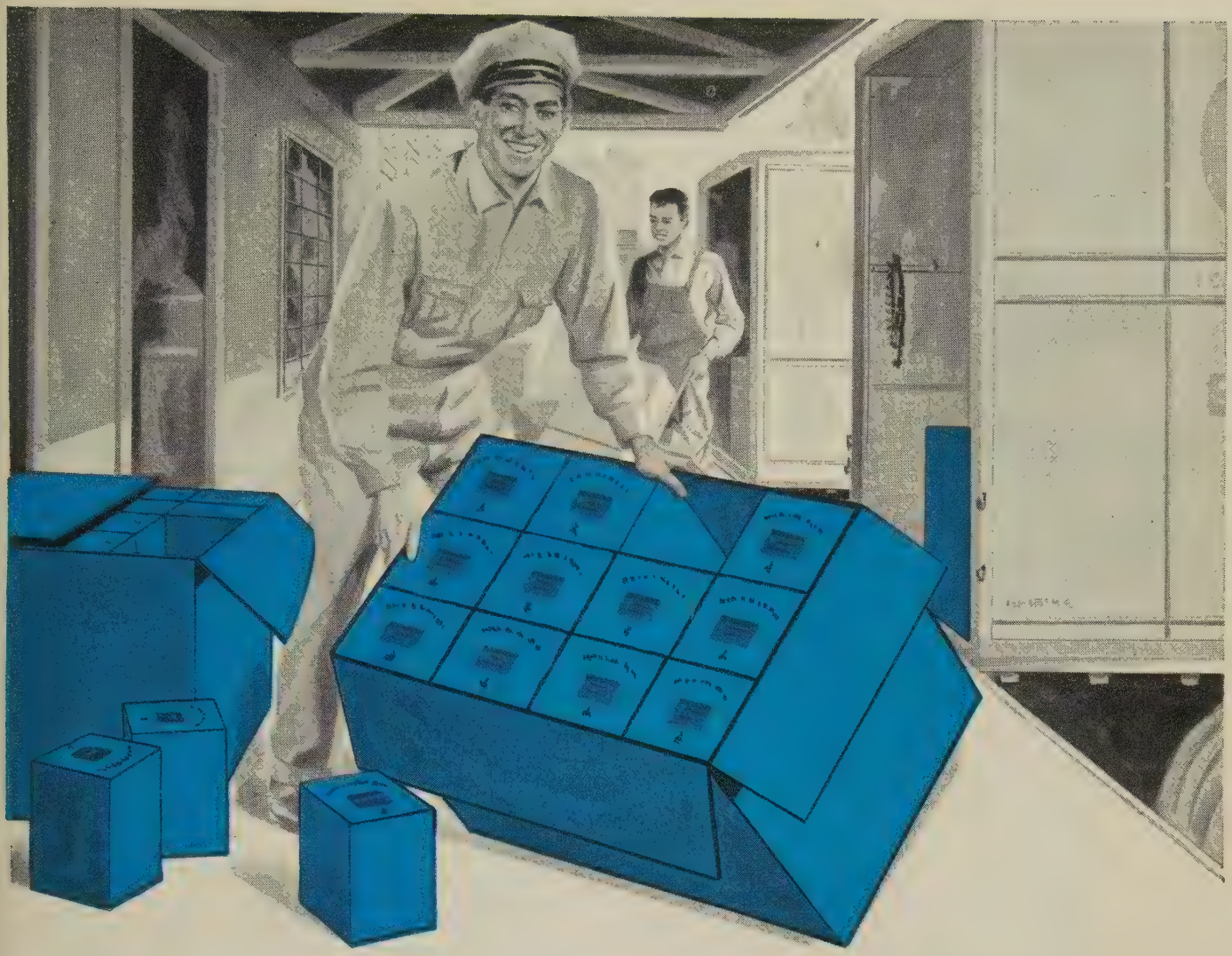
Type I:	
1. Water, lb.	1200
2. Modified cornstarch (7), lb.	200
3. Caustic solution	
(a) Water, lb.	42
(b) Caustic, lb.	21
4. Heat to 140°F., condensate, lb.	50
5. Mix 10 minutes	
6. Water, lb.	1433
7. Urea, lb.	50
8. Uformite No. 700, lb.	160
9. Mix 15 minutes	
10. Pearl cornstarch, lb.	1100
11. Mix till smooth	
Total adhesive, lb.	4256
Total solids, lb.	1419
Per cent solids	33.3
Type II:	
1. 250 gallons regular borated corrugating starch, lb.	2250
2. Pearl cornstarch, lb.	200
3. Urea, lb.	26
4. Uformite, lb.	87
5. Water, lb.	250
6. Mix thoroughly	
Total adhesive, lb.	2813
Total solids, lb.	702
Per cent solids	24.9

18. Chemically Stabilized Corrugating Starch—Non-waterproof

Stabilization of Carrier (in Steel Drum):	
1. Water, lb.	220
2. Caustic, lb.	1.6
3. Pearl cornstarch, lb.	160
4. Ketonic resin, lb.	2.4
5. Heat to 130°F., condensate, lb.	20
6. Hold 15 minutes	...
7. Empty into U-tank	...
	404 lb.
Preparation of Starch:	
1. Stabilized portion, lb.	404
2. Water, lb.	2300
3. Caustic solution	
(a) Water, lb.	83
(b) Caustic, lb.	31.5
4. Heat to 130° F., hold 10 minutes, condensate, lb.	100
5. Water, lb.	2424
6. Borax, lb.	33
7. Pearl cornstarch, lb.	1040
Total adhesive, lb.	6415.5
Total solids, lb.	1268
Per cent solids	19.75

19. Chemically Stabilized Waterproof Corrugating Starch (Reacted Process)

Stabilization of Carrier (in Steel Drum):	
1. Water, lb.	300
2. Caustic, lb.	2
3. Pearl cornstarch, lb.	200
4. Ketonic resin, lb.	3
5. Heat to 130°F., condensate, lb.	20
6. Hold 15–30 minutes	....
7. Empty into U-tank	....
	525 lb.
Preparation of Starch:	
1. Stabilized portion, lb.	525
2. Water, lb.	2175
3. Heat to 190°F., condensate, lb.	294



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4.	Neutralize with alum to pH 6.0	
5.	Urea-formaldehyde resin, lb.	72.5
6.	Alum, lb.	20
7.	Hold at 190°F. 15 minutes	
8.	Water, lb.	1400
9.	Cool to 140°F.	
10.	Pearl cornstarch, lb.	1250
	Total adhesive, lb.	5736.5
	Total solids, lb.	1472
	Per cent solids	25.7

Two-Starch System for Corrugating

E. S. GANTT

It is generally recognized that the viscosity of the starch paste used for corrugating is a compromise between the ideal for the single facer and for the double backer. This is particularly true in some instances where an excessively hot paste pan on the single facer or an inadequate flow of starch paste across the paste pan results in a tendency for the starch paste to cook on the fingers. One of the more effective ways of alleviating this condition is to reduce the viscosity of the paste. Various formulas have been evolved to permit this reduction of viscosity without a corresponding reduction in the solids of the paste where this reduction would damage the adhesion obtained.

The borax and caustic used in preparing paste for corrugating is usually between $2^3/_4$ and 3% of the starch used. The maximum amount of caustic is used to reduce the gelatinization point of the starch. The viscosity of the paste may be reduced by using $2^1/_4$% of both caustic and borax. This will also raise the gelatinization point of the adhesive slightly and thus help to prevent the gelatinization of starch on the fingers.

The use of a hydrolyzed or thin boiling starch for the carrier portion of the batch will appreciably reduce the viscosity of the adhesive. This will normally permit the use of higher solids in the paste and is consequently especially useful on machines with a short drying section. It is also advantageous when used with board which has a tendency to curl. The use of the higher solids in this paste will increase its cost since the amount of starch per 1000 square feet of board will be appreciably increased.

A higher viscosity, of course, is preferable for the double backer since the application is more easily regulated. There is, of course, no danger of gelatinization of starch in the paste pan on the double backer. The use of a thicker starch, particularly when the increase in viscosity is obtained by increasing the amount of caustic and borax used rather than an appreciable increase in the total solids, will result in a saving in the starch consumption.

Recently a number of corrugators have shown interest in the possibility of using two systems, one to apply the thin paste to the single facer and the other to provide a heavier paste for the double backer. In some particular instances this is unquestionably advantageous. My personal opinion is that in a great majority of cases the two circulating systems necessary and the additional work and supervision involved in maintaining the two pastes are not warranted by the results obtained.

Cold water jackets on the paste pans of the single-face machine and changes in the designs of the machine allowing better circulation of air and better insulation of the paste pan from the heat of the machine have greatly reduced the tendency to cook starch on the fingers. Improved starch circulating systems—particularly the use of adequate pumps and 2 or $2^1/_2$-inch circulating lines have improved the flow of starch to the paste pans. It is the exception now rather than the rule for a corrugator to have to stop during a shift to remove cooked starch from the fingers.

The compilation of answers obtained to the questionnaire sent out by the corrugating committee lists 42 plants. Of these only one designated OB indicates the use of two starches. In this instance a viscosity of 28 seconds is maintained at the single facer and one of 40 seconds at the double backer. Two and one third per cent of caustic soda based on the dry starch is used in the adhesive for the single facer and 2.9% in that for the double backer. This results in a gelatinization temperature of 145°F. in the adhesive for the single facer and 139°F. in that for the double backer. A heavy overflow is maintained at the paste pan and a flow of air is passed back of the pan at the single facer. The normal machine speed is 295 f.p.m. with a maximum of 500 feet and the starch consumption figure shown is 2.7 pounds per 1000 square feet for C flute, and 3.4 pounds for B flute.

The use of two starches is a subject certainly of general interest and it is highly desirable that the trade should be well informed of the possible advantages of this system. It is, however, doubtful if the use of different pastes on the single facer and double backer will be universally of sufficient merit to warrant the trouble and expense involved.

E. S. Gantt, Corn Products Sales Co., Chicago, Ill.

Operational Problems

S. DRUM

The operational problems of a corrugator, like all problems which face management of a container plant, must be accurately and specifically described before they can be intelligently handled. Because we each have different equipment, different material, different adhesives, and most of all, different personnel, we naturally have problems which differ in degree as well as in mind. We must also realize the foremen and the superintendents in the plants throughout the country do not interpret, evaluate, or attempt to solve the problems in the same manner.

In order to successfully cope with any problem area in our operation, five requirements must be met. We must (1) realize that a problem exists, (2) properly analyze and describe it, (3) desire to solve it, (4) possess or acquire the ability to solve it, (5) be capable of handling the human relations necessary for the solution. I would like to discuss these requirements.

A few years ago the laboratory men in our Chicago plant pointed out to us that there was a difference in burst test results taken across the web of the corrugators. The samples taken near the edge of the web tested consistently lower than those taken from the center. Examination of these indicated heavy pressure marks near the edges. The whole investigation led us to conclude we were actually damaging the liner at the single facer. As we started work on this problem we contacted other plants within and outside our corporation to find out if they had encountered the same difficulty. It was discouraging and somewhat embarrassing to be informed they had not, particularly as the solution became more and more evasive. However, after visiting these plants, examining and testing their board, we found we were not alone but rather in a boat which was loaded. They had answered our question as we would have before we knew a problem existed.

Not long ago we installed another single facer and adhesive circulating system in our Cleveland plant. At the same time we were experimenting with a new starch formula. We immediately encountered cooking in the pan. This had not happened to us before in Cleveland. We wondered about the type of starch, amount of caustic, the temperature of the adhesive

S. Drum, Container Corp. of America, Cleveland, Ohio.

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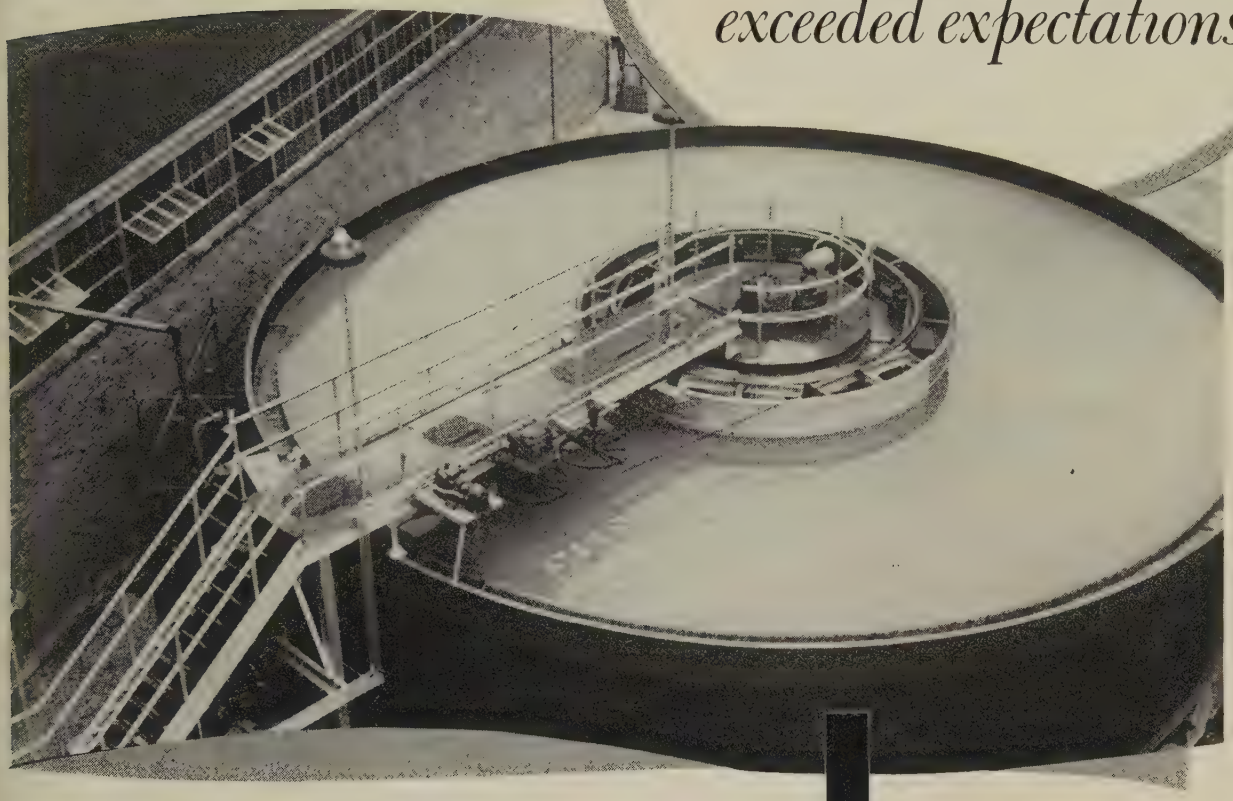

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and about our new circulating system. It was not until we compared the construction of our two single facers that we found the answer. There was a great difference in the position of the pressure roll with respect to the transfer roll and the pan. Our newer machine was closer to both and above rather than below the pan. We closed the steam line to our pressure roll and solved our problem because we had properly analyzed it. We have sufficiently high temperature and ample preheating (as we had learned in previous experiments) to enable us to operate without steam in our pressure roll. It may be necessary to find another solution as we wish to attain higher speeds.

To take a casual look at the third requirement which is to have the desire to solve the problem might lead one to think it is only natural that everyone should want to solve his problems. In actual practice this is not always true. It seems to me there is an alarming trend toward wanting someone else to solve them. How often we hear today: "That's not my problem"—"it's the laboratory's"; "it's the maintenance department's"; "it's personnel's"; "top management's"; or even "it's the government's." This is a method by which men not only limit or give up authority and responsibility in management, but can actually give up their freedom. It has been done, you know, and contrary to much wishful thinking, it could happen here.

At the opposite extreme, almost as ineffective though not as dangerous, are those who are willing to be "trouble shooters" but seldom solve problems on a lasting basis. They limit themselves and their subordinates by making every decision and withholding their little "gems of knowledge" in order to maintain a feeling and appearance of being indispensable. If more management men were willing to teach all they know and direct the growth of their subordinates, many difficulties would disappear. Add to this increase in knowledge of our operating personnel an active attempt to develop their sometimes "big ideas," and we would see more troubles fly out the window. Then create an environment in which people willingly cooperate and we can be sure of a tremendous reduction in the number of problems, and be certain that people are accepting their responsibilities.

When we talk about the ability to solve a problem, we must certainly think about the basic elements which make up the ability. These are a reasonable amount of intelligence, emotional maturity, understanding and use of scientific methods, and creative as well as judical thinking. All of these are necessary in the solution of personnel problems as well as mechanical and operational problems. However, as I will point out later, there is a need for social as well as abstract intelligence. Of these basic elements which make up the ability to solve problems our system of selection of management men takes care of the need for a reasonable amount of intelligence. It isn't too difficult to pick out the men who are more intelligent than the average, and it isn't necessary to have too much genius running around the place.

We mature physically through a natural process of growth, and in normal people mental maturation also takes place. Unfortunately, we do not fare as well with respect to emotional maturity. It is something which must be learned and developed through careful self-analysis and desire to improve. This is not easy because in many homes and in our society in general, emotional immaturity seems to have its comforting compensations. It has become difficult for people to gain a sense of responsibility and to free themselves of fears and hatreds. Under the scientific method, solutions are sought by gathering, analyzing, classifying, and interpreting pertinent data. The major steps of this method are stating the problem, establishing a working hypothesis, collecting data, reaching a tentative solution, checking the solution, and then putting it into application. The scientific method can be helpful in many areas of problem solving and should be used more generally even though it is difficult to apply.

I also mentioned the need to think creatively as well as

E. S. Gantt, Corn Products Sales Co.

Robert T. Cassady, Jackson Box Co.

judiciously. Most people are limited in this respect because few homes and few schools develop creative thinking. Children early in life have a world of it but parents and teachers proceed to beat it down until the individual conforms to the pattern and grows into adulthood thinking in terms of why new plans won't work. We find an almost universal desire among people listening to a new plan to jump up and shout, "It won't work . . ." After that start they must use all the imagination at their command to prove their point. If that same amount of imagination and a little effort were used in creative thinking, many good ideas would not be so readily opposed and so carelessly discarded. We should learn to look at a new plan, whether it is our own or someone else's with a desire to see the good in it. Perhaps by expanding it or contracting it, turning it upside down or inside out, it will develop into something really great.

We seem to place a high value on what we so loosely term experience. How often we hear people boast about their 20 years' experience, when they really mean one year's experience 20 times. Unless a man in management is growing, learning, solving new problems, and thinking creatively as well as judiciously, he certainly is not gaining much experience.

The last requirement in problem solving is to be capable of handling the necessary human relations. This indeed demands a high degree of social intelligence and is the most evasive, intangible, and perhaps the least considered of all. It is necessary in many situations that this capacity be exercised in two or more directions. We must sometimes sell our ideas to those above us in order to gain approval of the plan. When this is necessary, it is of course obvious and we know whether we succeed or fail. But in order to solve many of our problems on a lasting basis, if at all, we have to be sure our solution is accepted and executed by those operating our equipment. An indifference or passive resistance on their part often brings failure to an otherwise perfect plan. It is in this area where so many people in management are so inadequately equipped, and as a result are looking for mechanical solutions to difficulties which arise from improper handling of the human element in our operation. The skills of leadership, motivation, training, coordination, and communication have not kept pace with our technological advancement. We have come nowhere close to the potential capacity of our physical assets because we have not properly developed our human assets.

I have tried to discuss what I consider to be the most important operational problems in industry today. If we in management do as well in the development of people as we have done in the development of things, many of our present difficulties will no longer be present. We must prepare the foreman to function as a manager in his area of operation. He must have an understanding of economics, psychology, sociology, and a profound faith in the "American Way of Life." He must be capable of expressing himself well and

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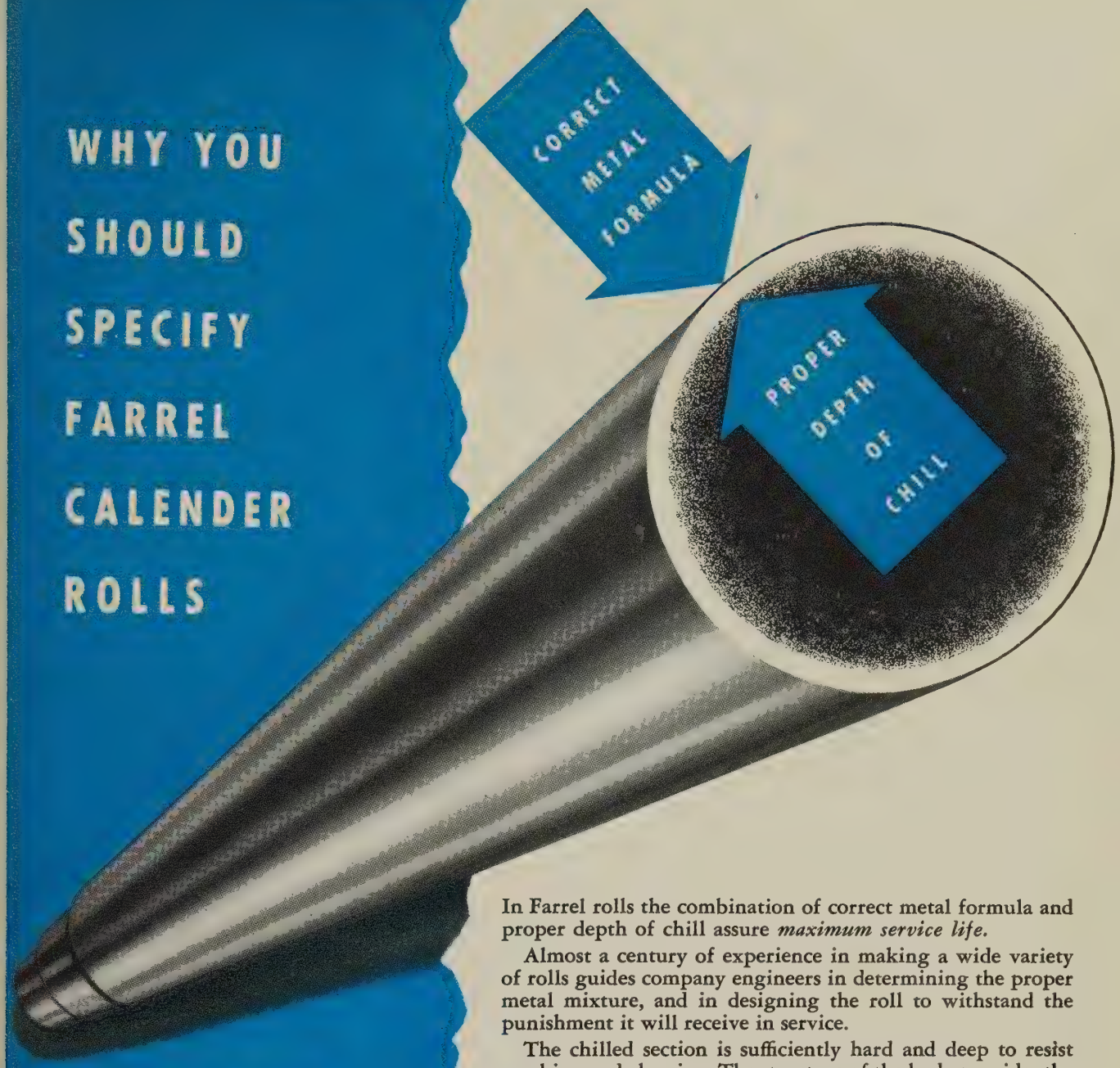

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Heat Balance on a Corrugator

ROBERT T. CASSADY

It has just been a few years ago that we were running our corrugating units without too much thought as to heat. We had other problems confronting us at the time which were much more important. These problems, such as how fast would our cut-offs run before they fell apart and many others of a similar nature plagued us to such an extent that we were more mechanical minded than steam minded. We not only did not have machines that were built for speed but the volume in the industry did not dictate a really aggressive production policy on the part of management. In more recent years the marvelous strides in the mechanical improvement of our equipment by the various machinery manufacturers, contributed greatly toward a change in our outlook toward production. We now have machines that will roll along, and it is up to us to provide facilities so that we may use them to their best advantage. Thus, today, I find your committee has thrown me a fast ball, namely a request to talk on "Heat Balance on a Corrugator."

The expression "heat balance on a corrugator" may be construed to mean one of several different things. Taking this fast pitch first as an inshoot, I will attempt to give you my thoughts as to balanced head on the machine as a whole unit in regard to its steaming efficiency.

Our foremost desire is to have each heat roll and hot plate transfer the greatest amount of B.t.u.'s possible at the fastest rate possible. In order to achieve this, one must study many outside factors, things which on the surface are small, but underneath play a large part in the over-all steaming potential of our corrugators.

First steam loads on a corrugator vary greatly according to conditions such as speed, width of board, temperature of board, climate, thickness of heat roll, and hot plate walls. We have found through our experience this load will vary from 25 pounds of steam per thousand square feet when running narrow board at slow speed to possibly over 100-pound per thousand square feet on wide board at high speed.

We must remember that the ratio between steam consumed and speed does not remain constant. There is a certain speed or peak at which each individual machine will utilize the greatest amount of B.t.u.'s available. From then on consumption of steam will more or less level off and tend to go down with speed increases. This peak we should consider the capacity of a machine, for it is at this speed we accomplish the transfer or extract the greatest volume of the latent heat of steam. This is achieved by the giving off of B.t.u.'s or condensing steam into water in the largest quantities possible. If we have a great volume of steam at a high temperature we are able and must run our board fast over our unit to appreciate an efficient operation If we run too slow on a very hot machine we lose efficiency through lack of this heat transfer, that is, no condensate being made, and if we run too fast or over our peak, a similar condition exists because transfer is too slow for speed.

Production figures in the industry today indicate at least 150-pounds pressure per square inch, preferably 175 or even 200 pounds are required with a minimum of 150 hp. Assuming that we have this desired boiler capacity we must then look to the piping of our corrugator. Are the feeding pipes as well as the draining pipes installed to handle steam and condensate in an economical and efficient manner? Last but not least, we must look to the very conditions of our water in the boiler room.

Pipes sizes may only be determined by machine size and makes of systems used. I will not go into this today as any one of the firms manufacturing these various systems can answer these questions after a survey of a particular machine. It is the methods used or installation policy or plan which one should stress as being most important, for here lies the secret of good steam transmission and condensate drainage. Do we use the least amount of fittings, valves, and bends so necessary to maintain a good dry steam without loss of pressure on our machines? Do we use welded joints every place where we are possibly able? Where threaded joints are used do we ream out pipe ends thus giving us smooth inside surface so necessary to high performance? All these so-called small matters are highly important for every joint: every bur, and every restriction of any kind in a pipe will lead to steam atomizing into water. On the condensate side of the machine if we use traps we must be sure they are the right size to take care of peak loads. The traps should be lower than the source from which they are receiving condensate and by the same token receiving pipes from the traps should be lower than the traps themselves. If we go overhead with condensate return, check valves should be used at every riser. By and large these rules follow regardless of the system, whether it be traps, restricted orifices, or straight pipe. It is a simple law of nature rather than engineering to bleed steam, which after all, is a gas off the top, and take water off the bottom of a pipe. Gravity should be used whenever possible in handling condensates. Where rolls or hot plates are bunched in rather close quarters it is best to return into the top of one common manifold. This will prevent the blow-by of a return pipe which, of course, might block off the flow of the one next to it.

You are probably wondering by now what system my company is using at the present. Frankly, the merits of one system as against the merits of another is highly controversial and is an age-old subject of conversation. I am not here to sell anything but only to tell you my thoughts on steam, so without going into a long discussion on the whys or wherefores will just say, we are using "the velocity steam system."

Last but not least there is one thing that could affect a corrugator operation though the piping may be ideal. The possibility of this is remote but nevertheless it does exist. This is water conditioning. In some areas we must treat our water quite heavily in order to maintain good boiler operation. As long as we must do this job it might as well be done with the utmost care. We should look to our treatment and keep in close touch with it. If this is done we will probably have a boiler water with a pH of around $10^1/_2$ to $11^1/_2$. If this pH would rise too much above $11^1/_2$ we would have a thoroughly saturated steam and in extreme instances a foaming condition and possibly a water carry-over to our machines. It is also desirable to have a deaerating receiver in the boiler room which would get rid of oxygen and other noncondensable gases from both the make-up water as well as the condensate return These gases if not eliminated from the system tend to bead in the inside walls of any heated vessel and will prevent the rapid heat transfer so much desired for high quality production.

A corrugator piped with a good system and with these

Robert T. Cassady, Jackson Box Co., Cincinnati, Ohio.

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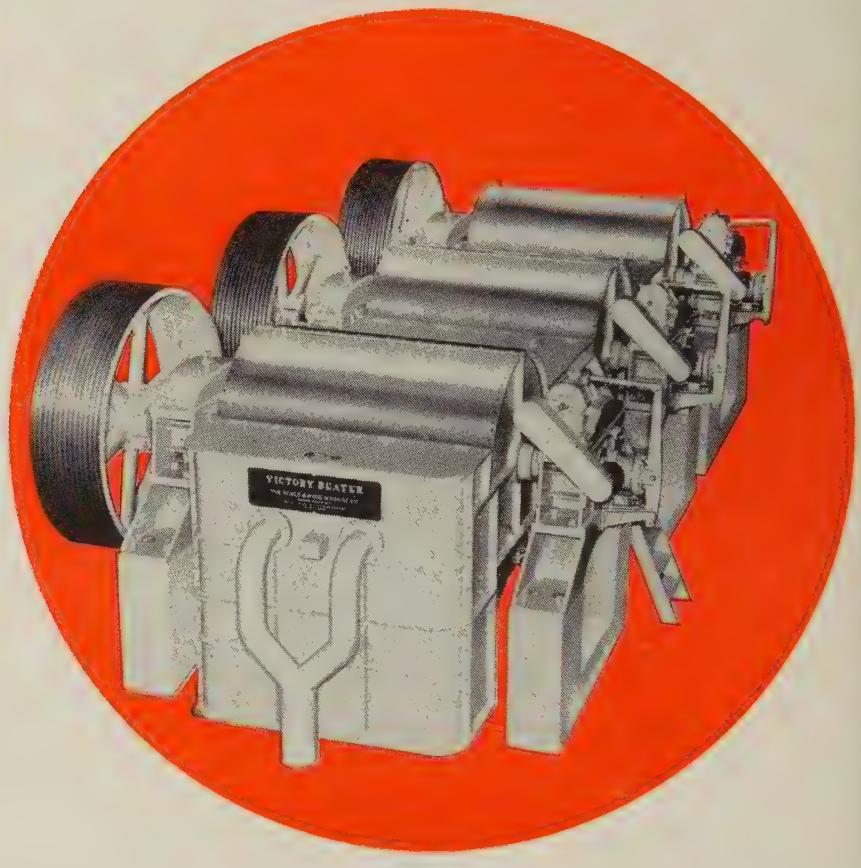

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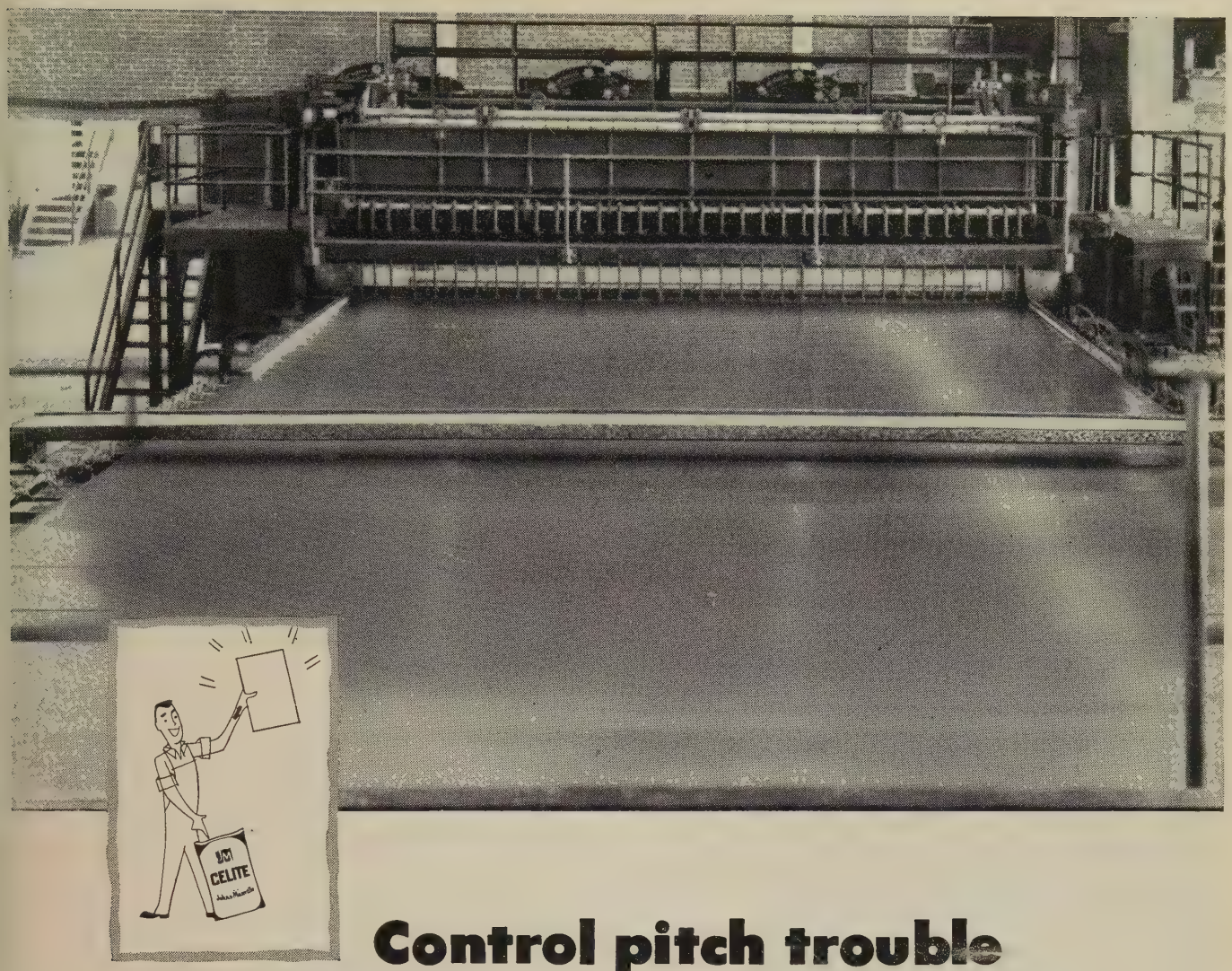

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basic piping procedures adhered to, along with good water and deaerating facilities, will steam evenly, every roll being as hot as the roll next to it. This we would call a well-balanced machine as far as steaming efficiency goes.

I can regard heat balance on a corrugator to mean the amount of heat applied to board on one portion of the machine in relation to the amount of heat applied to board on another portion of the machine. This is a very interesting question and I think one which should be looked at in a practical manner rather than a theoretical manner.

There is no set pattern for heat balance. Here are the reasons for this contention. First, most of us must put up with what we now have. For instance, a double backer in limited space with no room to lengthen it out as well as maybe no additional room for extra heat rolls gives some of us a problem pertinent to only our particular machine. Variations in silicate Baumé and starch paste formulas also make it difficult to set a standard for heat balance. The variations in corrugating mediums, some require more, some less steam showering, and differences in moisture contents of liner boards used, play a large part in the heat desired on our machines. Also we would like to remind you that the heat load demand from slow to fast speed is so varied as to make it almost impossible to have good balance throughout all speed ranges. True, we do have adjustable idler rolls on our large preheaters. With smart manipulation of these rollers we may cut down or or add additional heat when needed. All in all when it comes right down to it we must rely on our own ingenuity and practical knowledge of running board to get the best from our machines. We hear the often-repeated question, what do you do about warped sheets? This is, of course, due to the lack of good heat balance. Well, there are several different methods. One, the cutting off of heat on certain sections of the double backer is widely used. This is production in reverse. Psychologically, it has a bad effect on our men. It indicates a suggestion of slowdown by plant management. Is it not better to speed the machine up, thus achieving the same effect? This is what we strive to do in Cincinnati and we find it works much better.

We have tried to give to you our thoughts on heat balance first, on the over-all machine and second, on the machine in relation to its various units. I am more inclined to look toward the machine as to its efficiency in steaming as a whole unit. If we have success here we may help ourselves in operational methods for we will use a speed-up program to maintain good heat balance in most cases. After all, one can always cut off heat with additional speed (our way) or you may turn a valve thereby cutting off heat if you so choose. We prefer the speed-up method for psychological and production reasons and because we realize we cannot obtain heat on a system when the system is not built to have this additional heat available. Therefore, I say, give me a hot efficient machine, a crew with ingenuity and imagination to make adjustments, a sheet of board within fairly decent moisture limitations, and I believe, some fair success at heat balance will be maintained.

Testing and Quality Control in the Box Plant

D. P. McNELLY

Testing and quality control have usually been covered by at least one speaker in each of the programs on the manufacture of corrugated boxes that have been held by TAPPI and other sponsors during the past several years. Because the subject has been discussed several times from the standpoint of what can be done in the laboratory, I shall limit myself to the work that may be accomplished in the plant.

Over the years, nearly every manufacturing plant in existence has found it necessary, or at least desirable, to assign some of their employees to examining the work of others, before the product being made is delivered to the customer.

Inspectors have proved necessary for several reasons. Products have been getting more complicated. Generally speaking, they must meet higher standards; more is expected of a new automobile today than one made 10 or 20 years ago. With the advent of mass production each individual workman now performs a series of small tasks over and over, so that the responsibility for a satisfactory final product is divided among 10, 100, or even 1000 men. Depending upon the particular operation that a workman performs, any of these 10 or 100 men, may by himself, cause it to be faulty. To prevent the defectives from reaching the consumer, industry has gone to a great deal of expense to provide inspectors to catch the errors and get them corrected so the product being manufactured meets the customer's standards.

In the eyes of a layman a corrugated box is a very simple thing compared to most industrial products, and, since it is made of paper, has not been expected to meet high standards or to be of uniform quality.

I feel that the paper industry, and for the sake of our discussion, the corrugated box makers are behind most other industries in assuring the quality of their products and delivering uniform material.

The demands and requirements of the consumers of corrugated boxes are changing that. The users of corrugated are taking more of an interest in the boxes they receive. Some of the larger ones have put in their own laboratories and adopted standards that they require their suppliers to meet. Today, items such as cash registers, refrigerators, and glass tubing are being packed in corrugated. To do this, the box must be better than those made 10 years ago.

As far as an individual order or shipment of boxes is concerned, a laboratory can do very little to assure that it meets a standard, unless the shipment is held up while samples are tested. This means a wait of at least 24 hours or more while the boxes are conditioned in the necessary controlled atmosphere of the laboratory. It is usually not practical to store boxes in the plant because of the vast amount of space required by corrugated paper products.

The bulk of the testing and quality control work has been carried out in the laboratories rather than in the factories. Thirty-nine of the 42 plants returning the recent questionnaire make at least a bursting test, and around half of the plants made compression, puncture, flat crush, basis weight, and caliper checks in their labs. A very few box makers seem to have set up inspection systems that operate in the plant as other industries have found necessary or desirable. Less than half reported that they make anything but a visual check, and even less say they make any physical test to measure the quality of the boxes during the actual course of manufacture.

Of the number of plants in which production men or inspectors make tests during the process of manufacturing, more than half make a visual check of the board coming off the end of the double backer. What the visual check consists of probably varies between companies, but it may be assumed that it is at least a glance at the appearance of the board, ripping it apart to see if it is satisfactorily bonded together, and perhaps squeezing it to check the firmness of the corrugations. According to the data, 43% of the plants do not make any checks or inspections. Nearly half make caliper determinations. I think that more can be accomplished with a caliper while actually making the box, than with any other single testing instrument. If the caliper of the board coming off the combiner is at a high level, it indicates that the flutes are being formed properly and that the board is not being crushed anywhere in the machine.

D. P. McNelly, Quality Control Engineer, Fort Wayne Corrugated Paper Co., Hartford City, Ind.

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If the corrugating rolls are worn or misaligned, or the board is being damaged in the glue machine or double backer it can appear as reduced caliper.

Twelve of the 42 make bursting strength tests in the plant. These are probably rough checks, since they are being made on board that has not been conditioned. The limitations imposed by making the tests on unconditioned board should be recognized.

The next most popular test is measuring the resistance to flat crush, being made by six companies. These tests are subject to the same limitations as the burst tests since the board is not conditioned. Lower than usual flat crush values sometimes indicate fabrication defects such as leaning corrugations or board crushed in the glue machine or double backer. This test, when made in the plant, serves another and perhaps more valuable purpose. It is dramatic, one that the supervisors and machine operators easily understand. It helps to convince everyone that the management is interested in quality and strength. There is a danger of overemphasizing its importance, however. The flat crush resistance is not the final proof of the strength of a box. There is no single test that does that, although compression probably indicates it closer than any other.

Four plants check the glue pattern at the end of the double backer. This is done by stripping or soaking the combined board apart to expose the adhesive pattern. When using starch, the liner is dipped or painted with a solution of iodine and potassium iodide. The starch reacts chemically to produce purple lines on the liner. It readily exposes adhesive spread defects, such as wide fingerlines, spotty adhesion, excessive starch, and some fabrication defects such as high low corrugations. This test is made in an attempt to measure the bond holding the liners and the corrugating medium together, but, at best, it indicates only the presence of adhesive and does not guarantee that the board was bonded. The glue may have set before the liner and media were brought together, or before it penetrated one or the other.

Only one of the 42 plants regularly makes the puncture or pin adhesion tests.

For the past several years in the four box plants of the Fort Wayne Corrugated Paper Co., we have had an inspector working at the end of the double backer to check the board as it is being manufactured. A second man, also independent of production duties, follows with checks on the boxes as they progress through the printer-slotters, tapers, stitchers, and finally into the cars or trucks to be delivered to the customer. This program of inspection in the plants is supplemented by daily laboratory tests on boxes made in each of the four plants, and by checks on the rolls of linerboard and corrugating medium purchased by the company.

The series of tests made at the end of the double backer start by removing a sample of combined board from the take-off table, and noting the position across the width of the machine from which it was taken. Three tests are then made: caliper, flat crush, and rating the glue pattern.

The purpose of this inspection is not to fill out a fancy form with a jumble of numbers and letters that looks impressive and takes up file space, but rather to discover things that are wrong, and working through the corrugator supervisor and the machine operators, get adjustments made before too much substandard board is produced. If the inspector notes a sudden reduction in caliper, he brings it to the attention of the proper people who immediately dig into the problem and take steps to locate the cause of the damage and get the caliper back to normal. Whenever the inspector notes an adhesive defect such as a wide fingerline, he takes the liner that has been painted with iodine back to the operator and together they count over from the edge of the sheet to locate the particular finger causing the trouble. By checking for an accumulation of cooked starch on the end or by readjusting the finger, the defect is usually remedied.

The results of the tests and any action that was taken, are recorded on a form that is later reviewed by the plant manager and quality control department. I emphasize again the purpose of the inspector is not to make tests for the sake of the record, but rather to locate defects as soon as possible and get corrections made.

The operation of making corrugated board can be reduced to two things: first, forming flutes in a thin piece of paper; second, gluing a liner on each side of the corrugated paper.

The caliper and flat crush tests we make together measure the efficiency of the first part of the operation, forming the flutes. Rating the adhesive pattern, partially at least, measures the second, gluing the liners to the medium.

We feel the most valuable of the three tests that we make is measuring the caliper. If the crew of the corrugator make the highest caliper board possible, glue the media securely to both the inner and outer liners, and score the combined board properly, there is not much else that they can do to increase the strength of a box. If better board is required, better raw materials must be used.

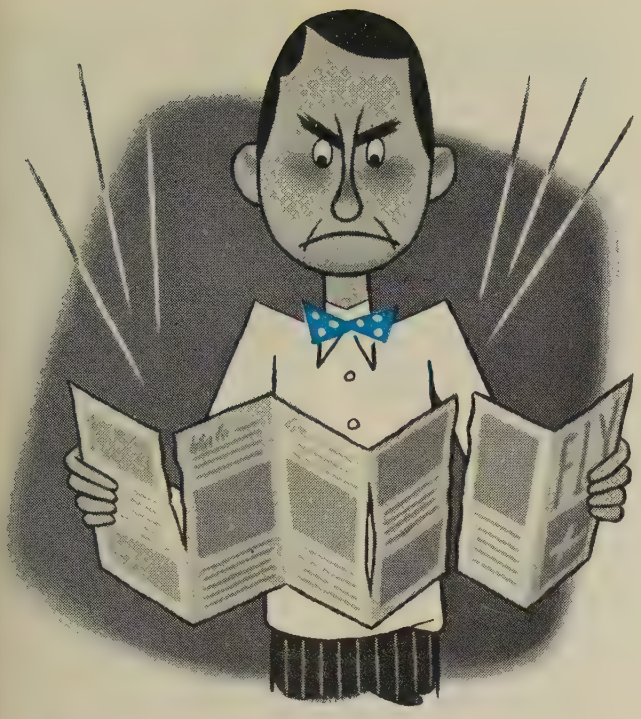
The second most valuable test is rating the glue pattern. This is our attempt to measure the strength of the bond holding the liners to the medium. If the glue is not spread uniformly, and is not present every place that it should be, the board cannot be bonded together as well as it might, since glue must be present to hold the liners and media together.

As mentioned earlier, the flat crush test is subject to certain limitations, since it is being made on board directly off the double backer, and not properly conditioned. The moisture content may vary anywhere from 5 to 12%, so that the results of the tests vary proportionately. If the flutes are not being formed properly, if they are leaning or distorted, the test results are low. If an excessive amount of steam is being used in the shower, or if an excessive amount of adhesive is being used, the combined board is very moist, and the flat crush resistance is low.

Other tests could be made on board fresh off the double backer such as the General Electric puncture or bending. I think it is important that at least one test measuring the physical strength of the board be made at the end of the double backer for psychological purposes. It cannot help but impress the employees throughout the plant that the management of the company is quality conscious. They think the strength of the box that is being made is important enough to justify the purchase of an expensive instrument for testing and hiring a man to use it.

The man that makes the tests is nonproductive labor. He doesn't make boxes. We feel that the use of this man is justified, however, for several reasons. First of all, he improves the quality of the board being made by discovering defects and taking steps to get them corrected before too much substandard board is manufactured. Second, the very fact that a man is assigned to do this work registers with the machine crew and with other men in the plant. If properly handled and capitalized upon, he is worth his wages in this function alone. Third, if the right man is assigned the job, one who keeps his eyes open, he can cut down the scrap being made and the starch consumed. Depending on the grade of board, the width of the machine, and the speed of operation, remember it is possible to make as much as $50 worth of scrap in 2 minutes.

Because of customer demands and requirements box makers and all other industries are continually being forced to find ways to improve their products, and still sell them at competitive prices. Other industries have found it easier to deliver material meeting the requirements set up by the consumers by inspecting their products as they are being made, and when completed. I believe that it will pay dividends to supplement our present quality control programs of inspecting raw materials, and the finished products in laboratories with more inspection in the plants by other than production personnel. If properly done it should result in a higher and more uniform quality box.



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STARCH DISCUSSION

1. What do you consider the best steam hookup for venting noncondensable gases?

Mr. Cassady: There are many methods which are satisfactory. I have just mentioned Langston and Velocity Steam Engineering

2. Have spray moistening systems been beneficial on corrugators in leveling out production troubles due to variation or improper amount of moisture in 9-point medium?

Mr. Drum: In certain situations water sprays have helped in balancing moisture across the whole sheet.

3. The data indicate that most plants measure caliper, basis weight, flat crush, G.E. puncture, and box compression. Do you feel that this list of tests is too small, ideal, or overlarge for policing production quality?

Mr. McNelly: Bursting strength should be added to the list. There is no one test for policing quality. Of those used, the compression test most closely approaches the answer.

4. Has the production schedule of the various plants, one, two, or three shifts, been taken into consideration when making up the finger life chart?

Mr. Mendlin: Yes, all data were corrected to a two-shift operation.

5. Would you give some information on the use of alginates? Are they economical? Do they assist in holding a uniform viscosity? Are they coming into popular use in the industry? If so, why? Do they affect the quality of the finished board?

Mr. Killinger: In starch paste, at a given temperature, alginates do tend to prevent breakdown. The use of alginates is quite wide and is increasing.

6. In your opinion, what is the permissible plus and minus tolerance in starch viscosity?

Mr. Gantt: We like to see it kept within 3 seconds.

7. Do you agree that heating the pressure roll is unnecessary?

Mr. Cassady: That all depends on the unit. The amount of heat has a relation to the speed being run. We like to use as much heat as we can get and run our machine fast.

8. What causes foaming of the starch as it enters the pan?

Mr. Killinger: There are several causes. The mechanical entrainment of air and biological decomposition.

9. What is the effect of borax on a waterproof formula?

Mr. Killinger: Borax cannot be used successfully in an acid-type paste, but can be used in an alkaline paste. It sets up cross linkages with the starch molecules.

10. What is your opinion of the value of the ply adhesion test as compared to either flat crush or caliper tests?

Mr. McNelly: The adhesion test measures a different characteristic than that measured by flat crush or caliper. The ply adhesion test is used to measure bond strength, and while the test is cumbersome, it is the best we have today. An allied test is the painting of glue lines with iodine solution, but this tells you only if the adhesive is present, not how strong the bond is.

11. What method would you recommend for a check of the proper operation of the corrugator steam system?

Mr. Cassady: Pressure gages are very useful on the single facer and double backer. Traps must be checked for proper operation. Deaeration of boiler feedwater must be complete.

12. Who does the quality control man report to?

Mr. McNelly: He reports to the production head or plant manager.

13. Do you feel that high flat crush goes with high caliper?

Mr. McNelly: Yes, to a certain extent. A properly formed medium will tend to have both.

14. What is your experience with glue roll speeds in relation to paper speed on the single facer? What are the results of too fast or too slow speeds?

Mr. Cassady: We have gone along with Langston using 97% of paper speed for our transfer roll.

15. Do you find much difference in compression tests between 42 and 47-pound liners? If using both, which would you use on the double facer?

Mr. McNelly: The compressive strength is proportional to the basis weight of the liners. I would say that you should expect about an 8% increase going from 42 to 47-pound. We would use the heavier liner on the outside of the box.

16. Do slower speeds improve compression tests?

Mr. McNelly: In general, no.

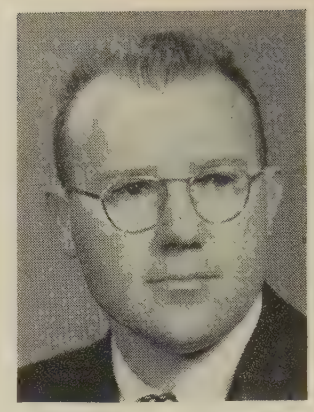
17. Does Kelsize improve or reduce compression strength because of keeping starch from penetrating the nine point?

Mr. Killinger: I can't answer that. Maybe someone else can.

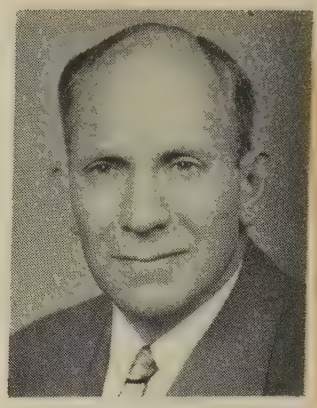
Mr. Mendlin: There are too many variables involved in a compression test to readily correlate compression with the use of alginate. Using a more direct test, namely pin adhesion, we have found that bond strength is increased with the use of alginate.

18. In general, what are the limits of wear that can be tolerated on A, B, and C-flute corrugating rolls?

Mr. McNelly: We change our corrugating rolls when the average caliper of 200-pound SW C-flute combined board gets down to 0.153 or below. A new set of rolls will make an average caliper of around 0.166 to 0.168, with occasional calipers as high as 0.173. If the rolls themselves wear the same amount as the caliper is reduced, which seems reasonable, we change our rolls somewhere around 15 thousandths of wear.



D. P. McNelly, Fort Wayne Corrugated Paper Co.



R. L. Kreyling, Philadelphia Quartz Co.

19. How many people in your plant are directly connected with quality control? How many corrugators do you have?

Mr. McNelly: We have four men in each two-corrugator plant, and six laboratory men servicing four plants.

20. If warping is caused by unbalanced heat, how does speeding up the machine change the heat balance?

Mr. Cassady: The board picks up less heat when you run faster. This lowers the board temperature and reduces warp.

21. Are there any board qualities such as stiffness and compression strength which are measurably improved by the use of more starch adhesive than is needed to form a complete bond?

Mr. Killinger: Stiffness can be slightly increased, but you run into diminishing returns. Too much adhesive can distort the board.

22. What pH is the starch adhesive run on the corrugator—Stein Hall process?

Mr. Killinger: On regular adhesive we add caustic to achieve the proper gelatin temperature, paying no attention to pH. On waterproof, the pH is from 10 to 10.5.

23. What is the difference in burst and crush tests between board hot off the corrugator and board seasoned a day in the plant?

Mr. McNelly: Board will be stronger in some characteristics with a high moisture content and stronger in other characteristics with a low moisture content. To eliminate all uncontrolled variables, we make all of our tests under standard conditions namely, 73°F. and 50% R. H.

24. What causes a stable meringue-type foam in the storage tank of a high caustic-low gel point double backer starch? What can be done to help this?

Mr. Gantt: You can get air entrainment, but that should not make for a permanent foam. Bacteria or protein will give a stable foam. The best thing to try is the use of a defoamer after cleaning.

25. What is the technique for testing wet burst on waterproof board? Is the board clamped tightly to crush the corrugations?

Mr. McNelly: Under JAN-P-108, you soak the board 24 hours, then shake the free water out, then clamp and test. The clamping pressure depends on the corrugating medium. It is always tight in our plant.

26. What in your opinion is the minimum per cent of starch solids that should be used in starch adhesive for the best economy?

Mr. Gantt: The minimum that I have ever worked with was 16%. As far as the most economical solids content is concerned, that depends on the plant and what the product is to be used for.

27. What do you consider the optimum gel temperature for the starch at the single facer? At the double facer?

Mr. Killinger: At the single facer the lowest that will allow circulation without gelation in the pan, about 142°F. At the double facer you can operate with a lower gel temperature.

28. What do you consider to be the optimum moisture content of semichemical? Of straw?

Mr. McNelly: I would rather not answer that. If I had to, I'd say about 7%.

29. Do you find that inspection at machine centers cuts down the initiative of machine operators?

Mr. McNelly: This is an individual plant problem. If properly handled, operators can be led to take on more responsibility.

30. What is the cost of chemical stabilization of paste?

Mr. Killinger: On a 600-gallon batch, about $1.00.

31. What progress has been made in developing an alkaline weatherproof formula?

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Mr. Gantt: Alkaline setting resins have been developed, but there is no guarantee that they will pull fiber.

32. At what speed do you think you can run an 85-inch corrugator efficiently with 150 p.s.i. steam?

Mr. Cassady: On a 78-inch machine you can make good board at 400 to 430 f.p.m. with 150 p.s.i. steam. On an 85-inch machine, speeds would probably be slightly lower.

33. How do buyer's laboratory tests compare with paper company tests?

Mr. Drum: Generally the customer is more particular than the supplier. Mills are a bit reluctant to tell their purchasers test results. It depends upon from whom you are buying board and the extent of their testing.

34. What are the chief causes of flutter, and what are the remedies?

Mr. Drum: Nonuniformity of the board. Possibly the setting of the rolls. You must consider the medium involved, but basically, the smaller the clearance and relief, the less flutter.

Résumé of Replies to Silicate Adhesive Questionnaire and Remarks on Efficient Use of Silicate

E. G. BOYCE

DURING the latter part of 1951, the Corrugated Containers Committee of TAPPI circulated a questionnaire to manufacturers of corrugated containers pertaining to the use of sodium silicate and starch adhesives in this field. I have been asked to summarize the 20 replies received on the use of sodium silicate and give a few personal comments on the efficient use of silicate.

ADHESIVE

Grades. Those replying used practically all of the commercial grades of silicate normally recommended for this use. Grades ranged from 3.2 to 3.4 ratio (3.2 to 3.4 $SiO_2/1.0\ Na_2O$) and 39 to 42.6 Bé. The grade of sodium silicate used is normally recommended by the supplier to give the best operating results with the local condition.

Handling. There were a number of questions on handling and storage of sodium silicate. It is agreed that an overflow system of the adhesive in the machine pans is desirable; that practically any size supply and return line is satisfactory, providing the flow to the machine is sufficient to take care of production at machine top speed, allowing for overflow to give good circulation and a return system to take full overflow when the machine is down. Normally a $1^1/_2$ to 2-inch supply line, reduced to $^3/_4$ or 1-inch drop to the pans with an overflow line of $1^1/_2$ to 2 inches is used.

Agitation of the silicate in the storage tank is not necessary. Better systems will return to the end opposite that from which the silicate is being removed.

Pumps. A number of makes and types of pumps were reported in use. Either positive gear or centrifugal pumps can be used for handling sodium silicate. The positive-type pump can be used for practically any use and is especially recommended where lifting or long pull is involved. The centrifugal type pump is satisfactory for circulation.

Consumption. The average silicate consumption reported per M square feet of board was 16.8 pounds (ranging 13 to 23 pounds) for A-flute, 18.5 pounds (ranging 16 to 26 pounds) for B-flute, and 18.3 pounds (ranging 16 to 21 pounds) for C-flute. Of this consumption approximately 43% of the adhesive is used in the single-face operation and 57% in the double-face operation. These average consumption figures are not out of line when wanting top quality compression board. However, good quality board can and is being produced at top speeds using silicate consumptions of 13 to 15 pounds per M square feet of board. This indicates that some of those reporting could improve their operation and save adhesive by looking into this problem of adhesive application.

E. G. BOYCE, Technical Service Representative, E. I. du Pont de Nemours & Co., Grasselli Chemicals Dept., Wilmington, Del.

MACHINE OPERATION

Roll Settings. Adhesive roll clearances ranged from 0.006 to 0.011 inch for the single-face units, and 0.007 to 0.014 inch for the double-face unit. The distance between the transfer roll and the corrugating roll reported varied considerably in these replies, ranging from 0.025 to 0.048 inch with most concerns using a clearance of 0.032 to 0.038 inch.

The question of adhesive roll settings and the distance between the transfer roll and the corrugating roll is one of interest. Adhesive roll settings will vary considerably from one operation to the other depending on the condition of the adhesive rolls and bearings, how they are operated, operating direction, and speeds that they are operated. Many of the better high-production operations that I have visited are those which reduce their clearances to a minimum and yet apply a uniform adhesive pattern. The high-speed units of today are using adhesive roll clearances as low as 0.005 inch on the single facers and some as low as 0.006 inch on the double facer. In problems of adhesive roll clearances, it is to the corrugated board manufacturers' advantage to contact either the machine or adhesive representatives for suggestions, and in many instances these people can improve your operation considerably. The factors of using the right clearance and the right grade of sodium silicate not only improve the board quality, production, and operating condition, but also are important in good housekeeping.

Adhesive Rings. It was generally agreed that no steps need be taken to eliminate wide or high adhesive rings on the adhesive applicating roll. To eliminate adhesive splashing, various means are employed, chiefly application guards and reduced adhesive roll speed. Normally, due to the viscosity of the sodium silicates used, the problem of adhesive rings and splashing is not serious and is easily corrected if encountered.

Fingermarks. Their general conception is that by using the proper adhesive roll settings and finger adjustments, and keeping the fingers in good working condition, fingermarks are minimized and, in many instances, eliminated. The fingers are kept clean by washing with hot water or scraping periodically. The tendency of silicate hardening on the fingers is minimized by applying the adhesive economically, having adhesive circulation and keeping the finger slots clean and in working condition. The average finger life of the 20 concerns reporting is approximately 3 weeks.

Strike Through. Less than 50% stated that they encounter striking through of silicate when running very porous corrugating medium. Various means were reported to regulate penetration of adhesives, namely, controlling application, use of preheaters, steam showers, and controlling adhesive temperature.

Warping. All agree that board warping is due to board moisture content. Warping is minimized and eliminated through the control of moisture in the board components during fabrication. This is done through control of adhesive application, preheating in the regulation of warp of the liners on preheaters to obtain uniform moisture distribution through the board during the bonding operation.

Steam Pressure. These companies use from 120 to 180 pounds steam pressure on the single-facer, double-facer preheaters, and first section of hot plates. On the second, third, and fourth sections of the hot plate, steam pressure was considerably lower, ranging from 35 to 170 pounds pressure. When using silicate, the steam pressure and heat on the machine should be regulated to fit in with the machine speed. When operating a machine with a top speed of 200 f.p.m., there is no need for high temperature, especially on the forward sections of hot plates. Even with high-speed machines

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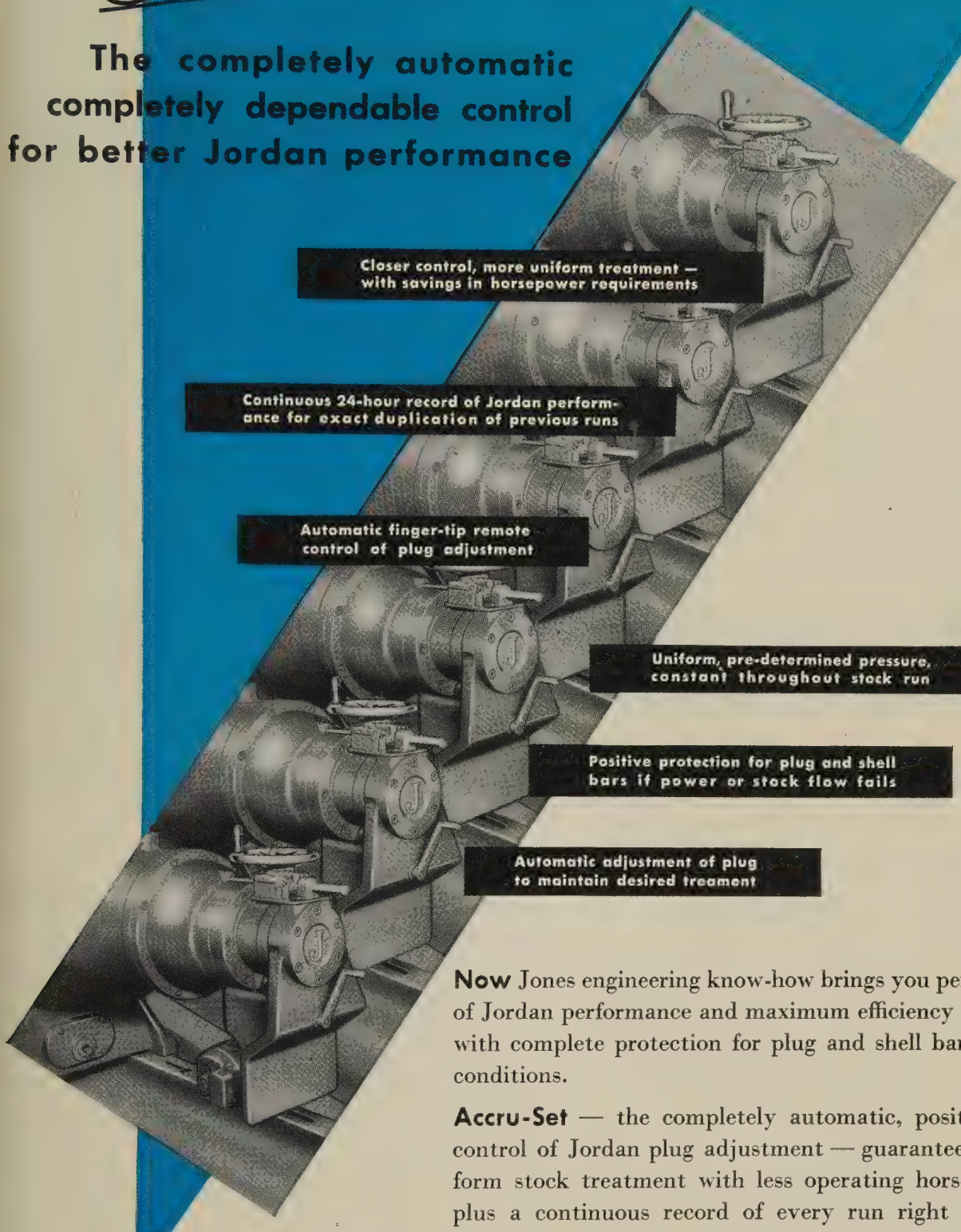
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of 400 f.p.m. or more, it is sometimes to advantage both in production and board quality to reduce the steam pressure of the last or last two sections of plates.

Checking Machine Temperature. They report checking their machine temperature with various types of pyrometers and thermocouples from daily to not-at-all. It is normally conceded that surface temperatures of the heating units of the machine should be checked at once if any difficulties are encountered, and weekly under normal operating conditions.

Machine Speed. The average minimum feet per minute of their machine speed is approximately 135 f.p.m., with a maximum speed of 347 f.p.m. and an average production speed of 233 f.p.m. It is regrettable that many of the high-speed operations using silicate either did not answer or receive a questionnaire. Machine speed depends upon the equipment, operator, paper, and adhesive. Unless each operation is studied separately, a stated speed is without meaning.

Preheaters and Hot Plates. Various sizes of single-face liner preheaters were used and all machines were, except one, equipped with preheaters ranging in size from 9 to 36 inches in diameter. Practically all the concerns reporting use double-face liner preheaters ranging from 8 inches to 36 inches in diameter. For a good operation, especially with the newer high-speed machines, large preheaters are practically a necessity to control moisture, warping, and good bonding. It must be remembered that large preheaters are installed for a purpose, and if used incorrectly can do as much harm as good. On light liners or dry liners or operating at low speeds, the wrap on the preheater should be reduced to prevent overdrying, resulting in cracked scores, crackly board, and possible silicate dust. On the other hand, when operating at high speeds or where using heavy liners or liners with high moisture content, the wrap may be increased to hasten bond set and reduce warping. Approximately 50% use the control loop at the single-facer bridge.

The hot plate section of the machines ranges from 32 to 49 feet in length, with the majority having the 33 and 44-foot lengths.

Parting Compounds. Approximately 50% of these concerns using sodium silicate report that they either use colloidal graphite or paraffin regularly or spasmodically to minimize adhesion of silicate to hot plates, while the remainder use no such aids. Here again, the adhesive application plays an important role in reducing this difficulty of silicate adhering to metal parts of the machine.

BOARD CHARACTERISTICS

Board Testing. Practically all checked the board for quality coming from the machine by visual and caliper tests. Eight concerns report no tests by quality control testers while the remainder rely on the bursting strength, caliper, and visual checks with 4 concerns of the 20 making thorough checks including compression tests. Practically all of the concerns reporting either check, or have their boxes checked at a later date by quality control testers for caliper, basis weight, burst, flat crush, G.E. stiffness, G.E. puncture, and compression.

Board Curing. Only one concern reported using exhaust blower to remove moisture from the board off the corrugator. This concern uses starch on the single facer and silicate on the double facer, while the rest rely on preheaters and hot plates for board curing.

Bare Streaks. Approximately half of the concerns answering report no percentage as far as bare streaks at the glue lines of the finished board. The others report bare streaks on the single-face liner of approximately 5%, indicating that they have made estimates and are encountering fingermarks. The average width of the bare streaks reported for the single-face operation of those reporting this condition ran from 0.04 to $^3/_{32}$ inch in width. In the double-face operation, four of nine concerns reported bare streaks in A-flute board ranging from 0.1 to 10% of their production, while the remainder encountered no bare streaks. In the B-flute operation, only three of eleven companies reported bare streaks ranging from 0.1 to 3%. In the C-flute, only one of six companies reported bare streaks amounting to 2%.

E. G. Boyce, E. I. duPont de Nemours & Co.

J. G. Lander, Diamond Alkali Co.

High and Lows. As for high and low corrugation, approximately one third reported no difficulty, two negligible, three in the 5 to 10% range, two within the 25 to 30% range, and four in the 60 to 85% range. High and low corrugations are troublesome and are due to the lack of heat and steam, worn equipment, or tension in the operation, or in the corrugating medium itself.

In this summary I have tried to cover the more important items, omitting many questions and answers on surface temperatures, steam pressure on various units, etc.

Silicate of Soda and the Relation of its Ratio and Specific Gravity to Corrugator Performance

J. G. LANDER

SILICATE of soda is a general term applied to a group of commercial materials all composed of different proportions of sodium oxide (Na_2O) and silica (SiO_2), in aqueous solution or solid form.

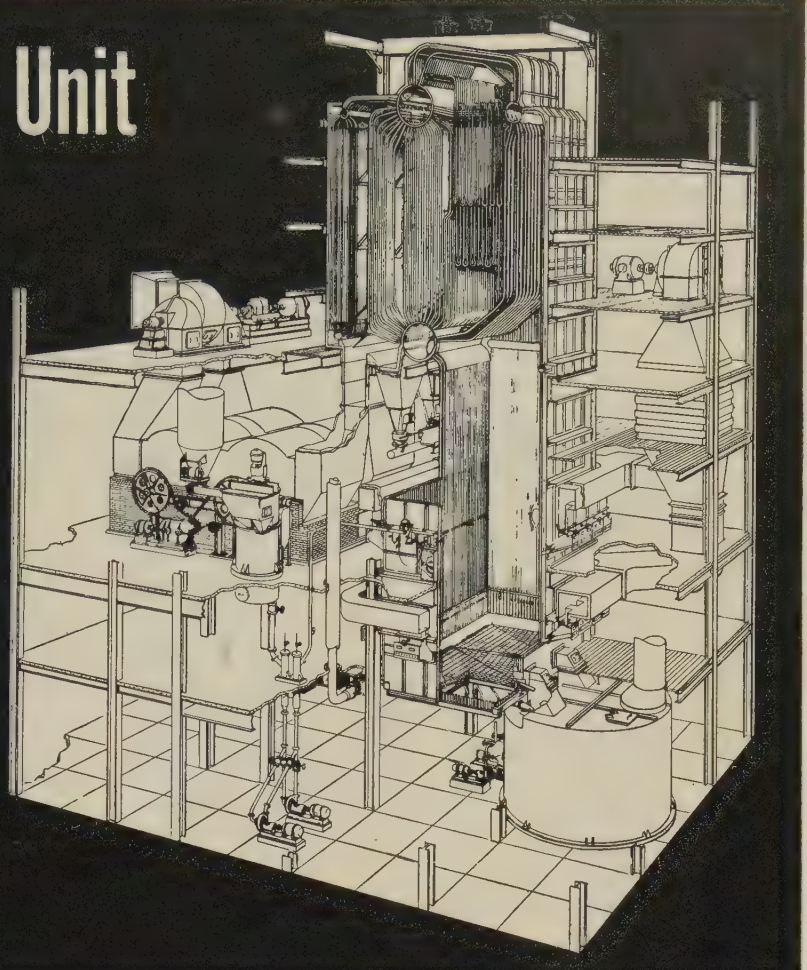
The ratio of proportion of sodium oxide to silica may be varied from 1 part of sodium oxide and 4 parts of silica up to 2 parts of sodium oxide and 1 part of silica. All ratio values given in this paper are on the weight basis. The concentration or water content, specific gravity, may also be varied. By carefully controlling these two factors the manufacturer is able to make various grades of silicate of soda having a wide range of physical and chemical properties. These properties make silicate of soda useful in a large number of industrial processes.

The corrugated container manufacturer is primarily interested in silicate of soda as an adhesive for the special purpose of combining corrugated board. Therefore, for him the ratio range is narrowed down to $1Na_2O : 3{\cdot}22SiO_2$ to $1Na_2O : 3{\cdot}40SiO_2$. Though it is possible to use ratios slightly lower or higher than those indicated, modern high-speed operations practically rule them out.

As the (silica) SiO_2 is reduced from 3.22 the silicate solution increases in alkalinity, and the setting time is progressively lengthened. Practically speaking, the solution is adhesive down to about $1Na_2O : 2{\cdot}85SiO_2$. At that point it

J. G. LANDER, Diamond Alkali Co., Cleveland, Ohio.

Recovery Unit Operating Conditions at New High



There is no question but that the trend of the pulp and paper industry, during the past few years, is to higher steam pressures and temperatures.

C-E Recovery Units now in service and others soon to be placed in operation, will produce steam at pressures up to 875 psi and at temperatures up to 825 F — and this includes units designed for capacities up to 350 tons.

Naturally some of the leading companies in the pulp and paper field are sponsoring this trend as is revealed by the list of C-E Recovery Units — now in service, under construction or on order — shown at the right.

It is not surprising that Combustion Engineering—Superheater, Inc., having been in the forefront of progress and development of the modern chemical recovery unit, is identified with most of the high pressure — high temperature units now in service or in process of fabrication.

B-577

	Oper. Press. psi	Total Steam Temp.
Gaylord Container Corp.	875	825
International Paper Company (Southern Kraft Division)	860	825
Longview Fibre Company	825	750
Macon Kraft Corporation	865	800
Mead Corporation	875	825
St. John Sulphite Ltd.	870	825
St. Regis Paper Company	625	825

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is extremely viscous and for adhesive purposes impractical for use in combining corrugated board, but has a definite utility for sealing both corrugated and solid fiber containers. As the (silica) SiO_2 is increased over 3.22 the silicate solution is reduced in alkalinity and setting time is progressively shortened. Here again, operational problems do not allow us to stray too far afield. As the ratio or proportion of silica is increased in the silicate solution, it sets more rapidly, and soon reaches the point where it proves impractical for combining corrugated board. Also, another factor enters the picture as the silica ratio or proportion is increased, the silicate solution becomes more sensitive as to viscosity change with temperatue change, and if the ratio is raised much beyond 3.3 or $3.4SiO_2$, the silicate of soda becomes difficult to handle in bulk shipment, storage, and in operation on corrugating equipment.

Thus the rate of set and temperature viscosity change are the limiting factors in governing the silicate of soda ratio range for corrugated use from $1Na_2O : 3{\cdot}22SiO_2$ to $1Na_2O : 3{\cdot}40SiO_2$ as confirmed by the replies to silicate section of adhesive questionnaires circulated by the Corrugated Container Committee.

These facts clearly indicate the critical nature of the ratio or proportion of Na_2O to SiO_2 in the manufacture and use of silicate of soda for adhesive purposes. For best results in combining corrugated board the silicate manufacturer must determine, with his technical service personnel, the optimum ratio that best serves the purpose.

Having determined the ratio, or proportion of Na_2O to SiO_2, the next step is one of practical engineering to determine the exact specific gravity at which a given ratio silicate solution will produce the desired results on a particular corrugator with materials at hand, and general operating conditions existing at each individual plant. This is a matter to be determined in the field with the aid of the silicate manufacturers' technical representatives.

Specific gravity is the ratio of the weight of a given volume of a substance to that of the same volume of some other substance taken as standard, water being the standard for solids and liquids. This may be given as such, or by some arbitrary scale such as degrees Baumé with which the user of silicate of soda is generally most familiar. The Baumé hydrometer is universally used for measuring silicate concentrations in the United States. The concentration of a silicate solution has great bearing on its rate of set, penetration, bond formation, flowability, and on the strength of ultimate bond produced, all of which must be taken into consideration to determine the optimum Baumé of a given ratio silicate of soda solution. On this point there is rather a wide range of choice that is available. However, there is a definite specific gravity or Baumé of a given ratio silicate solution for a given operation that will give the best results. When that is determined it should be rigidly adhered to.

The Container Committee Questionnaires make no mention of viscosity. Viscosity is the resistance of a fluid to the motion of its molecules among themselves. It plays a large part with the silicate manufacturer in deciding which grade of silicate to use for a given operation. However, because it cannot be accurately measured in the field, it is a technical detail excusably omitted. The box manufacturer being supplied a given ratio silicate of soda solution can easily use a hydrometer to check Baumé for control purposes. Knowing the ratio and Baumé of the silicate the box manufacturer can determine the viscosity from available viscosity-gravity-composition curves. It might be well to point out here that to continuously get accurate Baumé readings it is essential to have a clean hydrometer. Therefore hydrometers should be carefully washed immediately after use.

In years gone by when corrugator speeds were limited too far below the standards of today, silicate of soda of any reasonable ratio and Baumé more than met the box makers' adhesive requirements. The need for exploring the possibilities of

Charles D. Nitchie, Samuel M. Langston Co.

J. E. Wilske, Owens-Illinois Glass Co.

varying ratio and specific gravity was not there. However, during the depression days of the early 1930's when the need for reducing cost was paramount, increasing machine speed was the first line of attack. It was found that by choosing a silicate of soda ratio of higher silica value and adjusting the specific gravity or Baumé to a finer degree, greater machine speed and higher quality boxboard resulted. Machine refinements and continuing research on the part of the silicate manufacturer have caused this trend to continue. The replies to the questionnaires show a top corrugator speed of 500 f.p.m. Corrugator speeds of 400 to 500 f.pm. are not attained alone by the use of one particular kind or grade of adhesive, but by a combination of machine refinements, operating technique, maintenance, and silicate of soda tailored scientifically to the particular operation. In the process of tailoring the silicate to the particular operation, careful attention must be given to the following: (1) type and condition of equipment, (2) geographic location, (3) steam pressure available, (4) kinds of linerboard and corrugating medium used, (5) prevailing types of corrugated board produced, (6) standard of quality required, and (7) possible machine improvements and adjustments.

As machine refinements or improvements enter the picture and the silicate of soda is more closely geared to the operation, technique of operation must also be perfected.

Penetration of the adhesive is perhaps the greatest determining factor in speed of set, adhesive consumption, and strength of the finished bond. It is not hard to visualize that the correct concentration or specific gravity of a silicate solution is of the utmost importance in controlling penetration. Because high silica ratio silicates are less concentrated (have lower specific gravity), and require a lower water loss to obtain initial set, it is of increasing importance to adjust the specific gravity more exactingly. The responsibility of this critical adjustment rests with the technical service staffs of silicate manufacturers.

The box manufacturer, having determined with the assistance of the silicate manufacturer's technical service man the exact ratio and specific gravity (Baumé) of the silicate of soda to be supplied, is freed of further concern of the quality of his adhesive. That quality is precisely controlled by the silicate manufacturer. He gladly assumes the responsibility of delivering silicate of soda continuously to the customer's specifications. As a control within the box plant, all that is needed is a hydrometer to check the Baumé as previously mentioned.

After the silicate of soda is delivered, it is the responsibility of the box manufacturer to carry out recommended simple control procedure to avoid dilution which reduces Baumé and thereby lessens the efficiency of the silicate. That procedure can be stated in a very few words, namely, keep all water from draining in to the silicate pans or storage.

Time does not permit reviewing the mechanics of the for-

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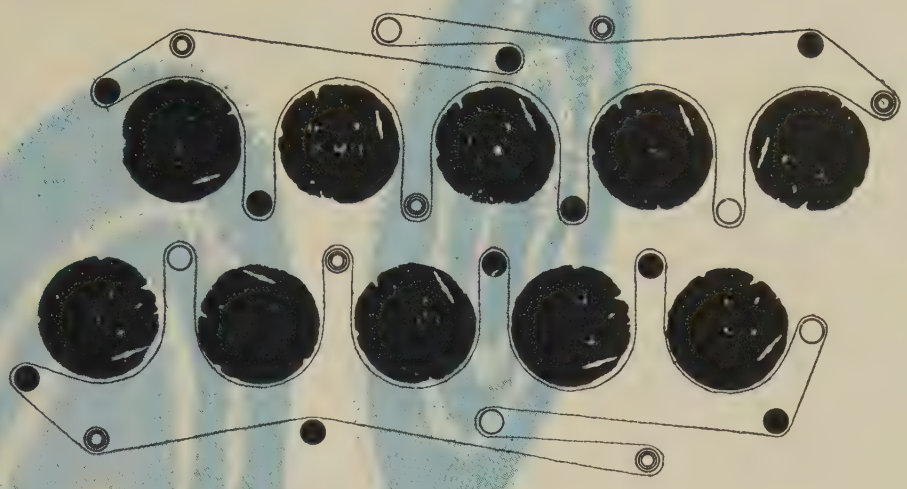

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mation of a silicate bond. To those who are interested in that phase, I suggest re-examination of a paper presented at the annual TAPPI meeting Feb. 19 to 22, 1940, entitled "Performance of Sodium Silicate Adhesives in the Manufacture of Corrugated Fiberboard" by E. R. Boller, J. G. Lander, and R. Morehouse. Also, an article in the January, 1949, issue of *Industrial and Engineering Chemistry*, page 81, entitled "Industrial Adhesives," by John H. Wills and Robert H. Sams.

Box Shop Planned Maintenance

C. O. KREEGAR

HAVING spent many years working in the maintenance department, mainly of corrugated box plants, I have always felt that management often does not understand the importance that good maintenance plays in the productivity of a corrugated plant. The maintenance departments in most plants are merely repair shops. Maintenance means to keep in a state of efficiency, therefore to get efficiency in this department management must have a definitely practical program for maintaining their plants. This has often been called preventive maintenance but I call it planned maintenance.

I believe my past experience has helped me to understand the needs of this department. Therefore I give it the same consideration as sales and production. And in so doing, I have built up the morale of this department to the point where the different tradesmen feel their responsibilities. It is clear to them they are no longer classed as repair men or third class workers. They know that so much depends upon the maintenance of machines of the plant that their work demands only men of highest skills. We usually select men from our production department that have mechanical ability and, with the aid of the machinery builders, train them to maintain our equipment.

In order to get a planned maintenance program started, we called the heads of the sales-service department, planning department, the shift superintendent, and supervisors of all departments into a meeting with the master mechanic. We discuss how to eliminate breakdowns which affect our production. It was brought out that we would have many breakdowns regardless of all that we can do. It was suggested we attack these breakdowns the same as we do safety. Every breakdown would be investigated by the maintenance department and the supervisor of the immediate department. In so doing we found that everyone of these breakdowns could have been avoided if the equipment had been properly maintained. Most breakdowns were caused by poor lubrication, excessive speeds, overloading the equipment, or lack of mechanical knowledge of the operator. It was decided that we would devote the time spent investigating these breakdowns to a weekly inspection of each and every piece of production equipment. One hour each week was allocated to examining the stitcher and semiautomatic tape machines, 2 hours for taper folders, 3 hours for printer slotters, etc. One Saturday out of three the corrugating equipment is shut down for 8 hours. When the taper folder is down the operator and helper clean and make the necessary adjustments. The machine is gone over by the electrician, two mechanics, and an oiler. The mechanical function is explained to the operator at this time. Worn and defective parts are either replaced or will be during the following inspection period depending on the need. We have 12 mechanical man-hours against this machine with 2 productive hours lost. But with two 8-hour shifts we are certain of 78 or more hours of uninterrupted production.

Our mechanical department is headed up by a master mechanic. He is responsible for all buildings and machinery. Under his supervision is the machine shop, tool crib, and stock room.

The tool crib clerk has the responsibility of filing all work orders under the number of each machine. At the end of each month the master mechanic with the plant manager review the work orders to see if there has been any excessive labor cost or repeat parts replacements, if so, this is investigated with the department supervisor to see if better parts can be had or redesigned to give better or longer service. All work orders are made in duplicate. The original is sent to the maintenance department. The carbon copy is retained by the department head for a follow-up. The work order form has a place for the date, machine number, department supervisor's name and space for a description of work to be done. On the back of the order is a space for the mechanic to mark in his clock number and time spent on the job. Every machine in our plant has a number. As the work is completed by the mechanics, checked and approved by the master mechanic, the order is filed against the machine. In this way we know at all times what it has cost us in man-hours to maintain this equipment.

I will give a brief description of the responsibilities of the various mechanics in this department.

We selected a man with some mechanical experience and then trained him to lubricate our equipment. We called upon an oil company and they sent one of their lubricating engineers to recommend the best types of lubricants for each job. This company furnished us with charts showing the type of greases and oils and the proper time to lubricate each machine part. The oiler starts his work 1 hour before the shift starts; he turns the steam on the corrugators and lubricates parts that cannot be handled during working hours. We found that by running oil lines from bearings to the outside frames of the machines would speed up this job, and the machine could be lubricated while in operation. This man covers the equipment closer than any other man in the plant so he has been trained to inspect all parts for wear and breakage. All minor jobs such as loose safety guards or loose bolts and nuts are taken care of at this time. He has the authority to have the foreman in each department write work orders for anything that needs the attention of the maintenance department.

The electrician makes an inspection on Monday morning of all motors, starter generators, elevators, lights, and fixtures. This takes approximately 5 hours. Any burnt contacts are replaced during the 10-minute rest period or at lunch time. Any electrical equipment that cannot be fixed during this time is reported to the department foremen for work orders. This work is planned by the master mechanic and the electrician to take place during the weekly inspection of the machine.

The pipe fitter spends 2 hours every Monday morning inspecting fire doors, sprinkler-system fire extinguishers, steam traps, silicate pumps, air conditioners, deep well pump, and sanitation equipment.

This department has men who specialize on the following equipment, taping and stitching, printing, die cutting and slitting, and corrugating. This manpower and knowledge are pooled for the weekly inspection of the different machines. We have one machinist in the shop at all times for machine work. We have a well-equipped shop with the most up-to-date machinery and tools that money can buy. We know this is most important for without good tools and machinery we can't expect to get efficiency.

Here are the benefits from our planned maintenance:

1. Higher production with the same machines.
2. Fuller utilization of direct labor because of less down time.
3. It has given the production departments the ability to turn out quality products at the rate required.
4. Greater plant safety.
5. Better housekeeping.

C. O. KREEGAR, Plant Manager, Interstate Container Corp., Glendale, N. Y

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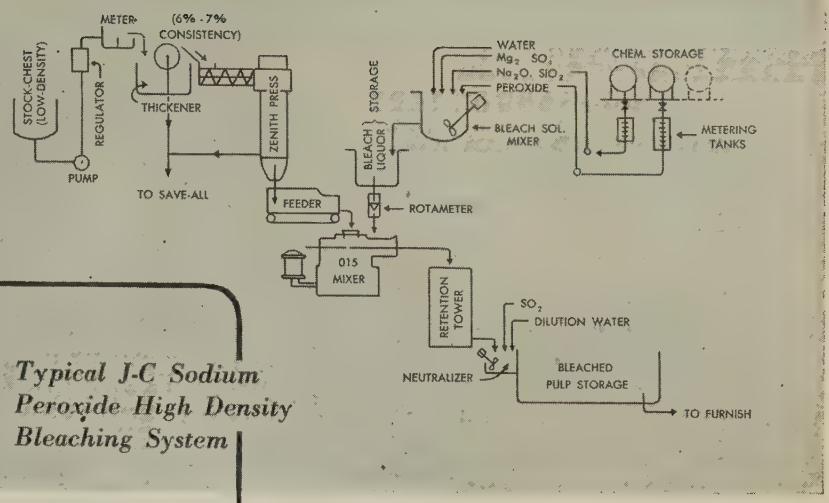

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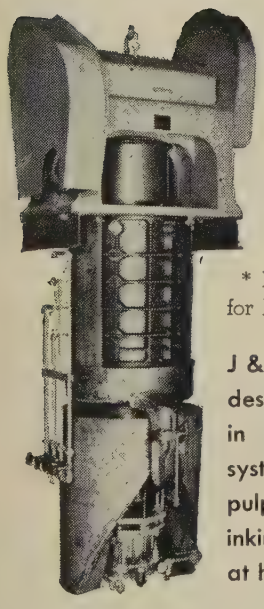

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6. Smaller inventories of parts.
7. Lower maintenance cost.
8. Better employee relations.
9. It gives the maintenance department time for large-scale moving operations.
10. Preservation of the life of the equipment.

With this planned maintenance program we know at all times what we are going to do, when we are going to do it, how we will do it, and what it will cost. We know we have not hit the ideal setup but have made some encouraging strides. We hope to keep on improving.

Clearance on the Corrugator

CHARLES D. NITCHIE

From the machinery builder's viewpoint, the most important factors affecting corrugatability are:

1. Design and production of a flute contour which would produce board of high strength and at the same time be compatible with the physical properties of paper.
2. Maintenance of adequate temperatures at the surfaces of the corrugating rolls.
3. Maintenance of intelligent adjustment of the adhesive mechanism to achieve adequate bonding of the single-faced without distortion of the accurately formed flutes.

All three of these factors are of equal importance, and any one of them can have a detrimental effect on the quality of board produced, even though the remaining two are ideal.

The machinery builder has complete control over the first factor. He, and he alone, can machine on the corrugating rolls teeth of a contour which will at high speeds mold and iron the paper into a flute contour of optimum strength without pinching or straining it. The machinery builder can also design an efficient steam and drainage system, and you, as management, can insure that this system is supplied with an adequate volume of steam at the required pressure and temperature. In the third factor, adjustments, we are both at the mercy of the operator's judgment. It is this third classification which your committee has asked me to discuss.

I wish that it were possible for me to tell you to set your transfer roll X thousandths from the large corrugating roll and Y thousandths from the glue roll, but this just isn't feasible. The type of adhesive being used, absorptive properties of the paper, Rehle test, roll temperatures, speed, and many other factors combine to make these roll settings variable from plant to plant, and even hour to hour in the same plant.

Over the past few years there has been an increasing emphasis on Rehle test. This has resulted in a corrugation of higher strength, but at the same time it has increased the springiness of the corrugated web and its resistance to confinement in the teeth by the fingers or crescents. It soon became apparent that with this type of medium, the old style of fingers with the long gradual relief section was detrimental to quality. The long relief ahead of the transfer roll allowed the springy medium to slip out of the teeth of the corrugating roll prematurely and set up a vibration or flutter ahead of the transfer roll. This flutter caused the web to vibrate up and down to the extent that as it passed over the transfer roll some of the flutes were missed or only partially made contact with the adhesive film, resulting in spotty adhesive application. Also, once the flutes were allowed to partially drop out of engagement with the teeth in the corrugating roll, it became difficult to push them back in uniformly, and high and low flute was thus induced. The obvious answer to this was not to allow the web to become active in the crescents, and the relief was greatly shortened and made shallower.

Charles D. Nitchie, Samuel M. Langston Co., Camden, N. J.

When this was done, the clearance between transfer roll and corrugating roll had to be decreased in order that the closer fitting fingers would not themselves interfere with the paper contacting the adhesive film. When this was done flashover of adhesive from the transfer roll to the corrugating roll outside the paper line began to be troublesome. This pointed up a shortcoming of the adhesive mechanism which had existed for many years.

Glue rolls had always been ground perfectly straight; transfer rolls, because of their smaller diameter, had more natural sag than the larger glue rolls. In order to maintain a uniform clearance between glue roll and transfer roll, it was therefore necessary to grind the transfer roll a few thousandths concave or smaller in the center than the ends. The result was that the transfer roll was closer to the corrugating roll at the ends than at the middle, which invited flashover. This fault was corrected by grinding the transfer roll convex or crowned to an extent that the natural sag of the roll would neutralize the crown and present a straight uniform clearance between it and the corrugating roll. The glue roll was then tailored to follow the crown and sag of the transfer roll by grinding it concave. This change was immediately recommended to the industry, and there are very few machines remaining today in which the adhesive rolls have not been reground to the new contour. This was an important improvement and pointed the way to greatly decreased clearances between transfer roll and corrugating roll. Whereas with the old-style fingers and concave transfer rolls clearance between transfer roll and corrugating roll of 0.030 was considered close, clearances of 0.014 to 0.018 are not uncommon today.

In order to maintain these clearances, close attention must also be paid to the clearance between glue roll and transfer roll to hold the film of glue on the transfer roll to the minimum commensurate with good coverage. These clearances will, of course, vary with absorptive demand in the paper, type, and viscosity of adhesive, but are usually around 0.008.

I have purposely confined my remarks to the glue and transfer roll type of adhesive mechanism since most of your machines are still of this type. The newer machines with the large combination fountain-applicator roll and doctor roll, provide a smoother glue film with less tendency toward beading, and thus can be run with closer clearances without resort to scrapers.

In closing, I would like to urge you, if you have not done so, to experiment with closer clearances. There is much to be gained in improved quality, and particularly as regards high and low flute and skips, lower adhesive costs, and longer finger life.

Thermo-Mechanical Requirements of Corrugating Units

J. E. WILSKE

The term, thermo-mechanical, means "the use of heat in combination with mechanical elements or arrangements." Thus this broad term can be construed to cover the art or process used in fabricating corrugated board.

This subject is very comprehensive and includes any phase connected with the use and control of heat and the mechanical devices used to apply the heat.

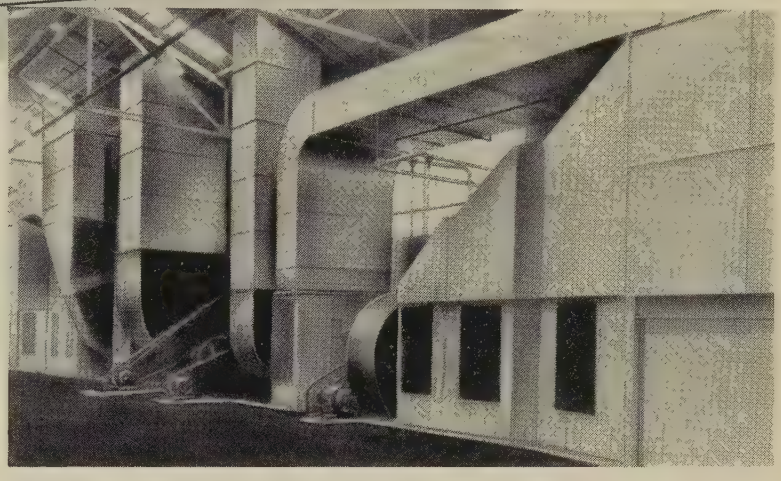
In the past few years much has been said concerning the use, control, and handling of steam on corrugating units, as well as the removal of condensate from the machine. We believe these points have been very well taken care of and can see

J. E. Wilske, Owens Illinois Glass Co., Alton, Ill.

Savings secured per 100 tons production with the ROSS-BRINER *Economizer*

Outdoor Temp.	Temp. after Briner Economizer	Temp. rise °F	Equivalent Steam		Savings per month of 25 days (75c steam)
			Lbs. /hr.	Boiler h.p.	
– 20 F.	72 F.	92	11,700	338	$5,260.00
0	78	78	9,900	287	4,450.00
20	84	64	8,100	235	3,640.00
40	90	50	6,350	184	2,860.00
60	96	36	4,100	132	1,840.00

Table above is for an average 100 tons per day machine operating 25 working days per month. Note equivalent boiler horsepower which is significant.



Ross-Briner Economizer apparatus on platform over hood in back of the machine.

a means for changing hidden waste to annual profit

The monthly savings shown on the table above represent the cost of steam that would be required without the Ross-Briner Economizer. Obviously such savings can rapidly pay the entire cost of the installation and thereafter return large dividends on the investment.

Where the Ross-Briner Economizer can be used to heat air for Vapor Absorption or, a felt drying system or to heat fresh or white water, the annual saving is further increased.

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no point in repeating the details of steam circuits and condensate removal systems in this discussion. All of these systems have one common end point, and that is, to maintain and control the thermal conditions necessary to produce quality board at high operating speeds with economical steam consumptions.

This discussion will be confined to the thermal and mechanical properties currently applied, as well as those desired in the operation of corrugating rolls, pressure rolls, steam shower, preheaters, and double-face ovens, to produce quality board at high operating speeds.

CORRUGATING ROLL FUNCTIONS

The primary function of corrugating rolls is to mold or form the corrugation. Heat and pressure are applied to both sides of the corrugating medium simultaneously with the molding action. The flutes are completely formed, one at a time and in rapid succession. In the case of C flute corrugation, a machine operating at 400 r.p.m. has to form corrugations at the rate of 280 per second. This means that the desired quantity of heat at high temperature levels has to be transferred from the corrugating roll to the paper through a relatively small flute area in $^1/_{280}$ second. It is quite obvious to those familiar with heat transfer problems that the corrugating rolls have a terrific thermal assignment. Since very small areas and time elements are involved, and both are fixed, about all that is left in the heat transfer equation for us to work with is temperature difference.

CORRUGATING ROLL TEMPERATURES

In the foregoing, you will note there is no specific temperatures or heat quantities mentioned. We do not recall ever seeing any facts or figures that would indicate the desired working temperatures of corrugating rolls. We also have no facts relative to the heat transfer coefficient that exists between the corrugating roll and the paper. What we know is pretty much handed down or obtained from actual operating experience. It is also generally accepted that forming the paper flute at high temperature materially improves its resistance to crush and other factors. Let's take a look at several actual corrugating units in operation today and see what steam pressures and resulting steam temperatures are in use.

The replies to the silicate questionnaire which was sent out by this Association to its members indicates that out of 19 replies, six concerns use steam pressure of 160 to 175 p.s.i., five use 150 to 160, three use 140 to 150, and five use 120 to 135 p.s.i.

The replies to the question of corrugating roll surface temperatures can be grouped into the following classes.

2 concerns maintain rolls at 300–310°F.
2 concerns maintain rolls at 311–320°F.
2 concerns maintain rolls at 321–330°F.
7 concerns maintain rolls at 331–340°F.
2 concerns maintain rolls at 341–350°F.
2 concerns maintain rolls at 351–360°F.

It is quite obvious that the majority of those reporting are maintaining surface temperatures of around the 340°F. level. This is the figure most frequently heard of as being the most desirable temperature. However, it seems like the phrase "or more" is always added onto any expression mentioning corrugating roll temperatures.

If you are satisfied with the 340°F. level, and assuming a drop of 30° in going through the corrugating rolls, one would have to maintain a temperature of 370°F. within the corrugating roll itself, which would mean a steam pressure of 159 p.s.i. Similarly, to maintain a 350 or 360°F. surface temperature would require steam pressures of 180 and 205 p.s.i. respectively.

CORRUGATING ROLL TEMPERATURE DIFFERENTIAL

The temperature differential of a corrugating roll might be subject to some controversy. We think of it as the temperature difference between the steam temperature within the roll and the surface temperature of the roll measured just as quickly as possible upon stopping the machine at the end of a run. Our experience indicates that this temperature difference should be held to the lowest possible, which would be in the 20 to 30° range.

It is interesting to note from the résumé of the replies to the silicate questionnaire that the average corrugating roll temperature differential of all concerns was 36°F. Two concerns were under 20°, five were in the 20 to 30° range, three were in the 30 to 40° range, and six were over the 40° range. Every 5° increase in the temperature differential is equivalent to a 12 p.s.i. loss in the steam pressure within the corrugating roll.

CORRUGATING ROLL HEAT TRANSFER

Why all the stress on temperature? It just happens that in addition to improving flute structure, this is the one important lever we have to pry more heat off the corrugating rolls onto the paper in a given time-area element. The flow of heat will take place where a temperature differential exists. In the case of corrugating rolls, the heat from the steam is conveyed through the side walls and through the paper primarily by conduction. In thermal conduction, the heat conducted through a layer of any substance in a given time is proportional to: (1) area across which heat flows, (2) the difference in temperature between the two surfaces, (3) the time, (4) varies inversely as the thickness of the layer, and (5) the K factor or coefficient of thermal conductivity of the substance.

You will note that the foregoing theorem mentions a layer of a substance, thus when we attempt to conduct heat through two layers of different substances, we get involved in two different K factors. Also, we may have to recognize a coefficient of heat transfer factor in going from one surface to the other, particularly if the mating surfaces are not in too intimate contact. In the corrugating process, we are conducting heat through two layers—one being the wall of the corrugating roll, a good conductor, the other, the paper layer, which is a poor conductor.

From the foregoing facts on heat conduction, we can arrive at three fundamental conclusions, as follows:

1. The rate of heat transfer from the metal surface to the paper surface can be improved by:
   (a) Increasing the temperature of the metal surface directly in contact with the paper.
   (b) Applying pressure to get the two surfaces into intimate contact.
   (c) Increasing the coefficient of thermal conductivity of the paper.
2. The temperature on the cold side of the metal can be raised by:
   (a) Increasing temperature on the hot side.
   (b) Changing the material to a higher K value.
   (c) Reducing the layer thickness.
3. The total heat absorbed by the paper can be increased by:
   (a) Increasing the time of contact.
   (b) Increasing the rate of heat transfer.
   (c) Increasing area of contacts.
   (d) Increasing the K value of the paper.

CORRUGATING ROLL THERMO-MECHANICAL RELATIONS

Several basic heat transfer functions appear in our corrugating process. For example, we have a mechanical pressure relationship involved which affects the thermal conduction to a great extent. The paper surface is relatively rough compared to the metal surface of the roll. Thus, the effect of pressure between the rolls results in the paper fibers having more intimate contact with the roll surface which increases the heat transfer to the paper. If you have closely checked corrugator operators you will find that they will invariably screw down on the roll tension springs whenever the roll

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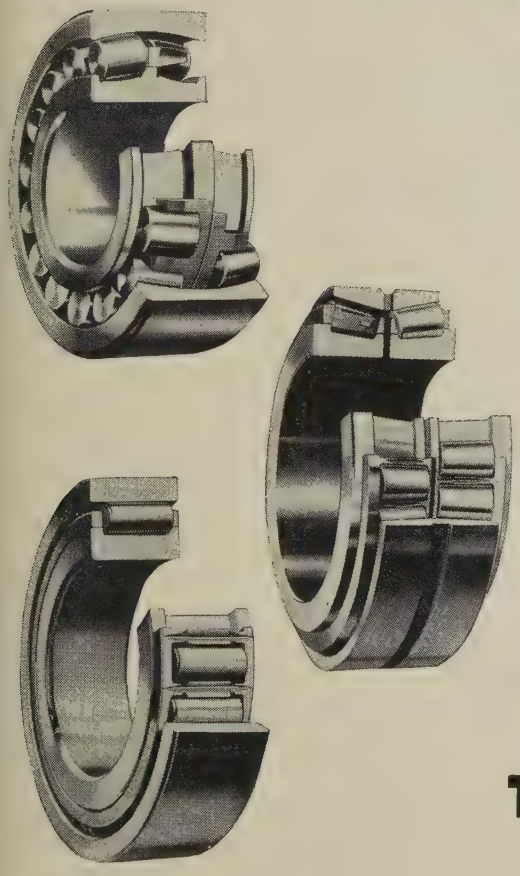

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temperatures are below par. If this pressure is excessive, the life of the corrugating rolls and paper quality will be materially reduced. If pressure is insufficient, we reduce the heat transfer and paper quality.

We understand that hydraulic loading arrangements are now available for use in applying pressure or tension on corrugating rolls. This arrangement, along with visible gages, would permit a constant check on the pressures used by the operators. There, no doubt, exists a certain desirable relationship between the nip pressure and the heat in order to form the most rigid flute structure. Hydraulic loading devices offer a visible means for obtaining the desired objectives on various widths and grades of corrugating mediums.

As food for thought, let's explore some of the other mechanical or design factors on corrugating rolls which influence heat conduction or transfer.

The material used in roll construction is an alloy steel. Other materials have higher coefficients of heat conductance. Copper, for example, will conduct heat eight times as fast as steel. However, the use of copper in place of steel will not affect the paper conductance coefficient, thus the paper will not absorb heat any faster from the copper material than it will from the steel. However, the substitution of copper for a steel roll under the same conditions will result in some higher external surface temperature. This higher surface temperature will expedite the rate of heat transfer. Copper, of course, is soft, has low tensile strength, higher coefficient of expansion, and lower modulus of elasticity than steel. In considering these factors, it is somewhat impractical to use the material for corrugating rolls.

Another mechanical consideration relative to heat transfer is wall thickness. If the wall thickness could be reduced by one half the thermal conductance through the wall would be doubled. This would result in higher surface temperature which, in turn, increases the transfer of heat to the paper. Thick walls are necessary for stiffness and to prevent the rolls from distorting. Larger diameter rolls will increase stiffness and reduce distortion, thus there is some possibility of reducing wall thickness on larger diameter rolls, thus increasing heat transfer rates. Already there is a trend toward larger diameter rolls.

SUMMARY OF THERMO-MECHANICAL REQUIREMENTS OF CORRUGATING ROLLS

Let's summarize the various items we have discussed relative to the thermo-mechanical requirements desirable on corrugating rolls.

It was stated that the minimum desirable surface temperatures in use will approximate 340°F., and more is desirable if operating speeds continue to increase. Our main outlet for increasing rates of heat transfer to the paper is to use higher internal roll temperatures, better control and application of pressure or tensioning devices, and possibly larger diameter rolls with thinner wall sections. All the foregoing is based on the fact that we are getting the most out of existing heat mediums.

In an effort to check on the thermal performance of the corrugating rolls, we heartily endorsed the practice of checking roll temperatures daily. Another control for watching the performance of the heating medium is to note the pressure differential between the inlet and outlet manifolds servicing the corrugating rolls. If this differential is maintained between 5 to 8 pounds, you are assured that you have adequate steam flow through the rolls.

As far as we know, all heat mediums in use on corrugating rolls today are steam. In order to increase the internal temperature of corrugating rolls, it is necessary to use higher steam temperatures which, in turn, means higher pressures. If one desired a temperature of 388°F., it would be necessary to use a steam pressure of 200 p.s.i. If 400 or 500°F. was desired, the pressures would be approximately 230 and 665 p.s.i., respectively.

Corrugating rolls, as made today, are good for pressures up to 250 p.s.i. Preheaters are rated from 175 to 200 p.s.i. and hot plates are rated up to 175 p.s.i. Of course, some of the older equipment would carry lower ratings.

It is quite obvious then we could go up to steam pressures of 250 p.s.i. on corrugating rolls, and 200 p.s.i. on preheaters. In view of this, it is possible to install small, high pressure, boilers to just service the corrugating rolls and use existing boilers for servicing the balance of the machine. It is also possible to install steam compressors to take lower pressure steam and compress it to higher pressure for use on corrugating rolls.

At the moment, it appears that steam pressures up to 250 p.s.i. are about the limit we can use on corrugating unit, and it is somewhat controversial whether or not we should go over 200 p.s.i. If, in the future, we require internal roll temperatures of much over 388°F., we will have to turn to other types of low pressure heat mediums, such as hot liquids, Dow-therm, Arochlors, and possibly direct-fired gas radiant heating. The use of these mediums will require considerable research and engineering development, and as such, we are unable to elaborate on their use.

Before leaving the matter of corrugating roll temperatures, we cannot help mentioning the fact that there is considerable need for the development of temperature recording devices for use in obtaining temperatures of the corrugating rolls and various paper temperatures while the machine is in motion. If we knew what these temperatures were we would certainly have better control of the corrugating operation.

The thermal requirements of pressure rolls are very much the same as corrugating rolls. They must have high rates of heat transfer to almost instantaneously set the adhesive and to evaporate a certain per cent of the water in the adhesive. The internal and external surface temperatures of pressure rolls should be maintained as high as is possible in order to maintain the highest rate of heat transfer from the metal surface to the paper.

In actual operation the thermal performance of the pressure roll, at times, might become the limiting factor on speeds. That is, we have occasionally seen instances where the single-face liner would blister and it was necessary to slow down to a point where these blisters would disappear.

The appearances of blisters on the single-face liners in a scattered nonuniform pattern is an indication that the pressure roll is not transferring sufficient heat to the liner. The operators can usually eliminate these blisters by increasing the tension on the liner. The operators believe that tension makes the paper taut and that this irons out and eliminates the blisters. This is only partly true. We believe that the more important result of tension is that it places the paper fiber in more intimate contact with the heating surfaces thus permitting more heat transfer to the paper.

Excess tension on the liners causes undue strains, more wear and tear on the parts involved, and increased power consumption. Thus the use of tension as a substitute for lack of heat on the pressure roll is highly undesirable.

The pressure roll also has a mechanical factor that increases its ability to transfer heat to the liner. We refer to the pressure arrangement for positioning the roll into intimate contact with the liner. As previously mentioned, the more intimate the contact the more the heat will be conducted to the paper. Of course, the application of pressure can be carried to a point where the paper fibers are damaged. Here again, it is undesirable to substitute excess pressure for lack of heat.

With the present mechanical pressure roll adjustment, it is difficult to measure the application of pressure. No doubt, if we go to hydraulic loading of corrugating rolls there will be a demand for hydraulic loading of the pressure roll. This

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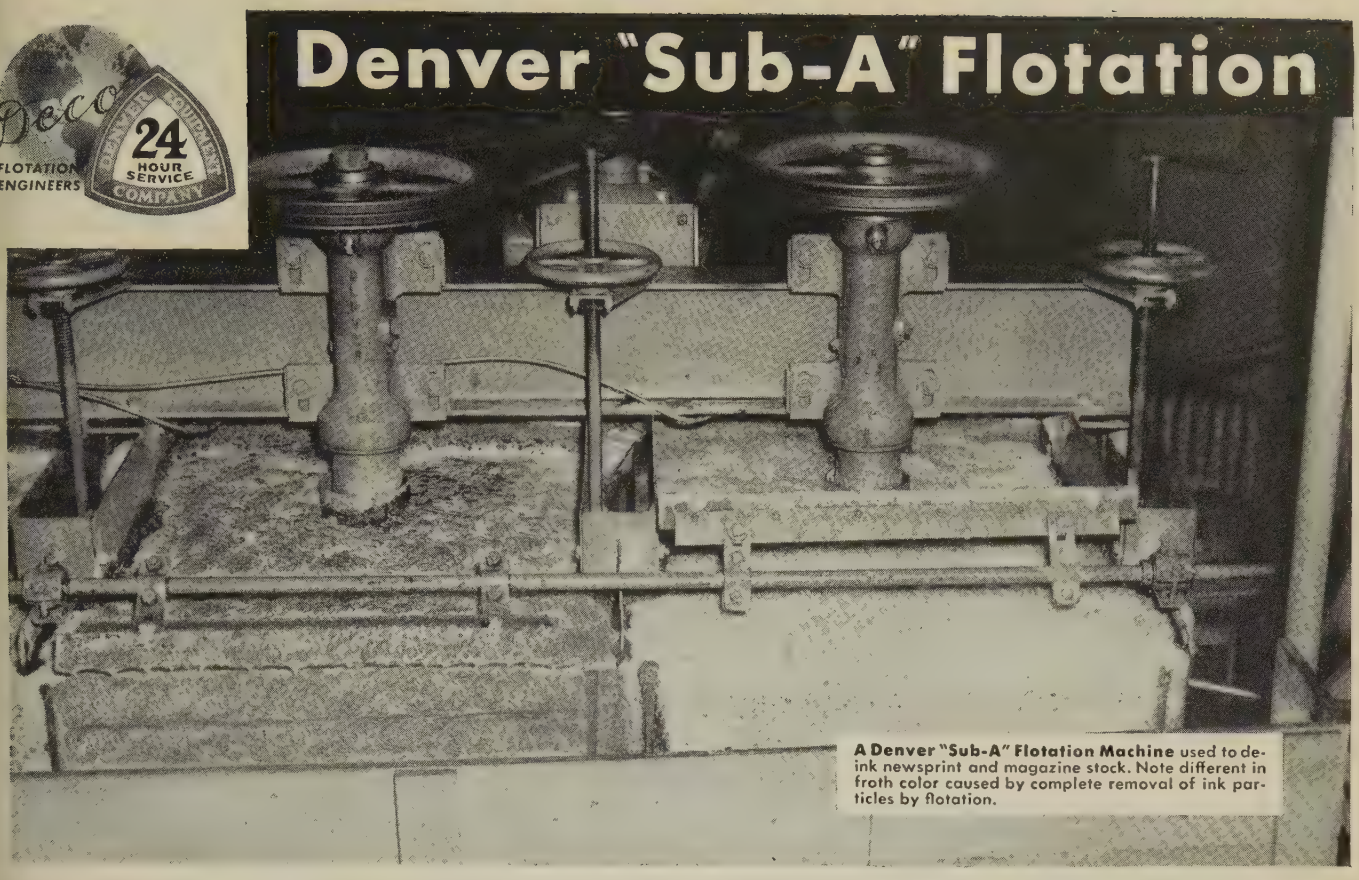

A Denver "Sub-A" Flotation Machine used to de-ink newsprint and magazine stock. Note different in froth color caused by complete removal of ink particles by flotation.

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of course, would permit the use of gages and we could visibly see the pressures in use by the operators.

An increase in the diameter of pressure rolls would tend to increase the rate of heat transfer because the area of contact with the paper would be increased. Then, too, larger rolls would improve the heat recovery factor. Larger diameters might also permit thinner wall sections without sacrificing rigidity.

In summary of the thermo-mechanical requirements of pressure rolls, as discussed in the foregoing, we can state that high rates of heat transfer are necessary to instantaneously set the adhesive. Higher operating speeds will involve the use of higher internal temperatures to effect increased rates of heat transfer. Better control of pressure application is desirable. Larger diameter rolls with possibly thinner wall sections will also increase the heat exchange rate.

Steam showers are probably one of the most mysterious thermal elements in use on corrugating units. This probably results from the fact that it plays a dual role and it is difficult to determine which phase is the most important. Steam showers supply both heat and moisture to the corrugating medium and we must say that present-day showers are very efficient.

We believe that most operators think of the steam shower as a moisture device and that when they turn on more steam to improve the sheet they feel that moisture did the trick. Our experience is that up to a certain point we need the moisture and heat, and beyond that point we need the heat value only. However, we must, of necessity, take the moisture.

The application of heat to the corrugating medium, through the direct application of steam, is a very quick way to heat up the paper, but it is an expensive method. In a way we can visualize the steam shower as sort of a heat valve to use in cases where the corrugating rolls are not transferring sufficient heat to the paper to form a good flute. In other words, the steam shower functions as a preheater in that it starts the paper on a temperature rise so the corrugating rolls will have less trouble in completing the necessary temperature rise.

The excessive use of a steam shower as a substitute for lack of heat on corrugating rolls is certainly not desirable. Excessive moisture in the corrugated paper reduces the flat crush tests and probably contributes to warpage, washboarding, and lateral shrinkage of the corrugating medium which will cause the liner to pucker.

The pressure requirement of steam showers is somewhat controversial. Where we attempted to operate with pressures below 100 p.s.i. the operators complained that they had insufficient steam for the shower, even though steam was completely traveling through the sheet. It was necessary to increase the pressure to about 135 p.s.i. We are inclined to believe the need for this increased pressure was the need for increased heat rather than moisture.

With reference to the mechanical design of steam showers we have nothing to offer along the lines of desired improvement.

The thermal function of preheaters, as the name implies, is to preheat the liners from room temperature up to a higher temperature level before the paper enters the corrugator or double facer. These are used singularly and in series. Some small diameter preheating drums are attached directly to the machine. The larger diameter preheaters are self contained, and are treated as separate machine elements. My discussion will relate to the individual preheaters.

Practically everyone uses the same steam pressure on the preheaters that they use in the corrugating rolls. The surface temperatures of preheaters as reported in answer to the silicate questionnaire vary from 300 up to 360°F., depending upon the steam pressure available at the various plants. Here again, as on corrugating rolls, it is necessary to maintain high temperature to increase the rate of heat transfer from the heating surface to the paper surface. The paper traveling over the preheating drum are not in too intimate contact with the heating surface, and as such, it will not absorb heat as rapidly as that going through corrugating rolls under pressure. However, the preheater has large heat transfer surfaces and the paper is in contact with these surfaces for sufficient time to reach a desirable temperature. Heat transfer rates can be improved by imposing tension on the paper at the roll stands.

This preheating of liners or corrugating mediums before they enter the corrugating and pressure rolls and double-face ovens means that these machine elements have less heat to transfer in completing the process of forming a flute, setting the adhesive, and evaporating some moisture resulting from the adhesive.

Preheaters have a mechanical adjustment for varying the wrap or arc of contact of the paper with the heating drum. This effects a control of the heat applied to the liners and its resultant temperature as it leaves the preheater.

In actual operation, preheaters are used for several purposes, namely, to raise temperature of the paper, to reduce moisture content, to control warpage, and to open up the paper surface for improving glue penetration. It is not possible at all times to accomplish or use these various functions simultaneously. A lot depends upon the various operating conditions that exist at any particular time. Thus at times it is necessary to determine the worst problem present and to use the preheaters to overcome that problem and sacrifice the other benefits.

For example, take a case where the preheaters are in maximum use and the paper is warping toward the single-face side and you are having difficulty adhering the double-face liner. The warpage can be improved by taking the heat off the double-facer preheater, but this loss of heat from the liner will further complicate the adhesion problem. We would elect to reduce warpage and then slow the machine down to effect the adhesion.

Another example would be an instance that we are frequently faced with where we have all the preheaters on and have difficulty with warpage or adhesion and we find the paper shrinking considerably in width as it goes over the preheater. In this case, it is necessary to remove the preheat entirely and thus lose the entire effect of heat and warpage control.

From our experience we would say that preheaters lack one thermal requirement and that is a temperature control. We would prefer to run full wrap and vary the temperature. With this control the operators could always thread through the preheaters and use what heat they wanted. Now they have to guess whether or not they want to thread through or skip it.

From the mechanical viewpoint, we know of no design changes that might improve the thermal function of the preheaters. We have seen times when we wished they were larger in diameter. No doubt as operating speeds continue to increase it will be necessary to increase the heating surface.

The thermal requirement of the double-facer ovens is to set the adhesives and to evaporate the excessive moisture in the board. These ovens are mounted side by side and extend for some length in a horizontal plane. The amount of heating surface is indicated by the number of plates or the length of heating surfaces. On modern high-speed machines the length of heating section is approximately 42 feet in length.

A top cotton belt running over the plates is used to convey the board across the ovens. The board, of course, is positioned between the belts and the ovens.

With reference to the surface temperature maintained on the ovens there seem to be two schools of thought which are probably determined by the type of steam circuit employed. One system uses high temperatures on the first section and then varies the temperatures on the balance of the sections. The other system employs equal temperatures on all ovens and varies the temperature of the entire group.

The replies to the silicate questionnaire relative to double-face oven temperatures indicate that the general trend is to

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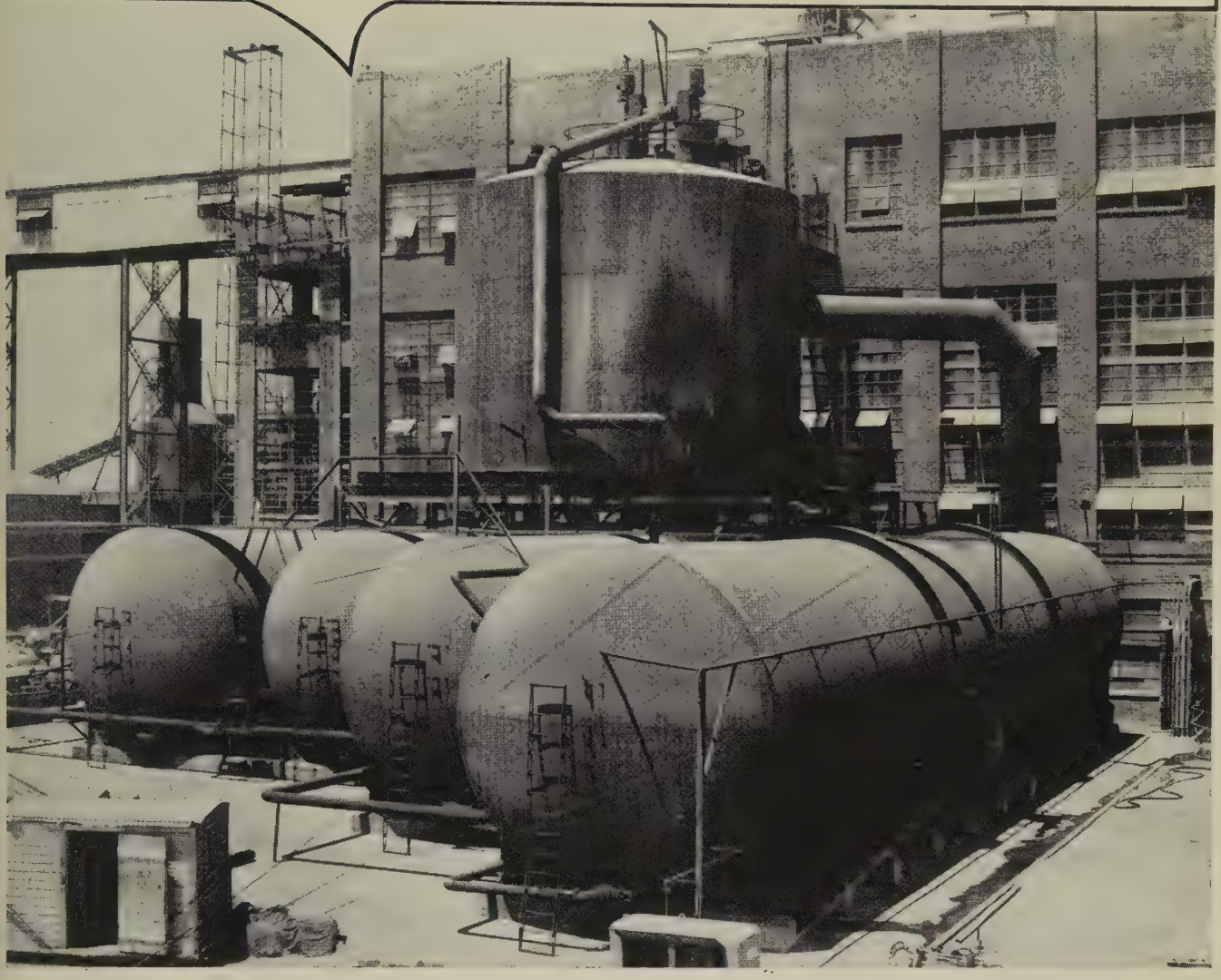

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keep the first section of ovens around 340 to 350°F. In other words, 7 out of the 18 reports received listed temperatures below 340°F. and the balance were above 340°F. In instances where the 2nd, 3rd, and 4th sections are carried at lower temperatures, these values were usually 15 to 20° below the 1st section temperatures.

Paper traveling over the double-face ovens is not in too intimate contact with the heating surface, and the rate of heat transfer is somewhat low. However, the long heating surface compensates for the low heat transfer rates and ample heating and drying of the board normally take place.

There is one mechanical arrangement on double facers which tends to improve the thermal function. We have reference to the idler rolls which apply pressure to the belt which, in turn, applies pressure to the paper in an effort to gain more intimate contact with the oven surfaces. This pressure is ample and usually some rolls are left in a raised position to reduce the possibility of crushing the board.

Another item to consider in thinking of maintaining the best possible heat transfer from the double-face ovens is to keep them clean, level, and on a line. Films of paper fuzz and adhesives act as insulators and materially reduce heat transfer. Out-of-level ovens reduce the contact area and reduce the quantity of heat absorbed by the paper.

The double facer is usually on the end of the line so far as the steam circuit goes and as such it is liable to receive the least attention and suffer the most from the lack of heat. Regardless of what steam system is in use, it is highly important to properly maintain the system if you are to obtain the best heat transfer situation.

In the future, if we desire to operate at higher speeds, it will be necessary to increase the temperatures of the ovens and also lengthen out the heating surfaces. This is on the assumption that our good friends, the adhesive people, do not develop a cold-setting adhesive in the meantime.

SILICATE DISCUSSION

1. You say that pressure drop across rolls should be 5 to 8 p.s.i. What would it mean if this jumped up to 15 pounds?

Mr. Wilske: Either steam flow has increased considerably, or there is a restriction in the system.

2. How have coatings other than Teflon worked out on the fingers?

Mr. Nitchie: We haven't found any other coating that will stand up under the temperatures involved.

3. What is the best way to get a maintenance program started?

Mr. Kreegar: Call the supervisors in and point out what the maintenance department can do for them.

4. Why do we have so many minor troubles with stitchers and taping equipment?

Mr. Kreegar: Cleanliness is the biggest factor. Stitchers, knives, and taping equipment must be clean at all times.

5. Do you think anything can be done, heat-wise to reduce shrinkage of paper in going over the preheaters and through the double-face ovens?

Mr. Wilske: Shrinkage is due to paper characteristics and the moisture in it. Try to get uniform moisture content paper.

6. I have noticed that adhesive rolls you have shipped us recently look rough. Is this a poor finish or is there a reason for it?

Mr. Nitchie: This is done on purpose. A rougher grind gives an adhesive film freer from beading than a smooth roll. We have also etched some rolls with phosphoric acid to make the surface more receptive to adhesive. Also, because of complaints that starch dries on rolls that are idling, we are engineering them to level off at a speed of 150 f.p.m. when corrugator rolls are reduced to idle speed.

7. Would it be possible to use dielectric heating for the double facer?

Mr. Wilske: The cost of power to supply the same amount of heat would be five or ten times the steam costs and therefore prohibitive.

8. How do you get maintenance men to feel the responsibility of their jobs?

Mr. Kreegar: Call the mechanics in on production meetings.

9. With short relief fingers, if you run into a roll of paper that hangs up in the roll and won't fluff out—what then?

Mr. Nitchie: There are two things that can be done. The easier way is to run the transfer roll up closer. The other is a new oil mist lubricator which produces a very fine spray of oil. We found that the oil spray didn't look good to lubricate corrugator rolls, but Downing Box, using an Alemite system with a spray header, finds it does an excellent job for them. Langston will have these units available shortly.

10. What has been developed in the way of a cold setting adhesive for the double backers?

Mr. Lander: At 500 f.p.m. the job is most difficult. Adhesives are being developed which will set with less heat, but I don't think we'll ever get completely away from heat.

11. What is the order of magnitude of pressures between the corrugator rolls and between the corrugator roll and the pressure roll?

Mr. Nitchie: The pressures in both cases are about evenly balanced. The center corrugating roll is straight, the other two crowned. The small corrugating roll carries a little more crown, but has slots in it. The end result is that both rolls straighten out to conform to the straight center roll. On hydraulic installations the pressure between the corrugator rolls is about 100 pounds per inch.

12. Has any progress been made toward developing a waterproof silicate?

Mr. Lander: Philadelphia Quartz has been working on a waterproof adhesive. There is a waterproof silicate adhesive, but with many ifs, ands, and buts.

13. Is it better to get the roll clearances while the rolls are running or when they are stopped?

Mr. Nitchie: It is better to get them while running. If the rolls are out of round, it will average out.

14. Why not use a hydraulic loaded pressure roll as well as a corrugator roll?

Mr. Nitchie: We are working on it.

15. Would greater heat transfer be obtained if 36-inch preheaters were positively driven?

Mr. Nitchie: I don't think so because the more drag the better contact and the greater heat transfer. If the preheater were to try to drive the board, contact would be poorer.

16. Why shouldn't the transfer roll be a little closer to the corrugating roll in the center, where it is always covered by paper?

Mr. Nitchie: Actually, the crown tolerances are in that direction. With clearance of 0.014 inch and paper of 0.009 inch, you can't have much crown.

17. What good does preheating the double-backer blanket do in reducing warpage?

Mr. Wilske: We have never attempted to do anything with the double-face belts. If we had all preheaters on and double face was cupping toward the single-face side, we would cut down on double-face heat to retain moisture in the double facer so the board would pull down as it later dried. We might also add more glue at the double-face gluer to put more water into the double-face side, and at the same time decrease the glue line on the single facer.

18. Have you had any experience in perforating blankets so as to get rid of trapped moisture between hot plates and blankets?

Mr. Wilske: I have never heard of a belt made that way.

19. What methods do you use to check and maintain glue rolls on corrugators?

Mr. Kreegar: We use a thickness gage with a dial indicator. The responsibility is left to the master mechanic.

20. What would you say is an economical steam consumption figure for a corrugating unit?

Mr. Wilske: It varies all over the lot. If we are consuming 50 pounds per M square feet, we think it is good. We go to 70 pounds per M square feet. Many operators go wild on the use of steam showers when roll temperatures may be at fault.

21. Have you any information on silicone resins or greases as a preventive material to stop sticking of the adhesive on fingers?

Mr. Nitchie: No.

22. Regarding the Teflon coating of fingers, does the coating have any effect percentage-wise on the average life of a finger? About what premium is the Teflon coating expected to cost per finger?

Mr. Nitchie: We haven't used Teflon enough to really tell, but I suspect that it may promote life of the finger. Gobs of adhesive on a finger case flutter, which will wear out a finger fast. The cost, initially, was $1.00 per finger for the coating. Now we can get the cost down to 35¢ if we order in 5000 lots.

23. Do you consider it necessary to use a preheater on the single-face web?

Mr. Wilske: We are not using preheaters on the bridge, but the tendency is toward them.

24. Do you believe a preheater for the corrugating medium is essential?

Mr. Wilske: All of our machines have corrugating medium preconditioners. We feel they have helped our operations very much. We must insist that our operators use them, although, with certain types of paper, we don't want heat.

25. Which side of the liner should be next to the preheater on the double facer?

Mr. Wilske: We put the outside of the liner against the preheater. I haven't studied the case enough to know which way it should be done.

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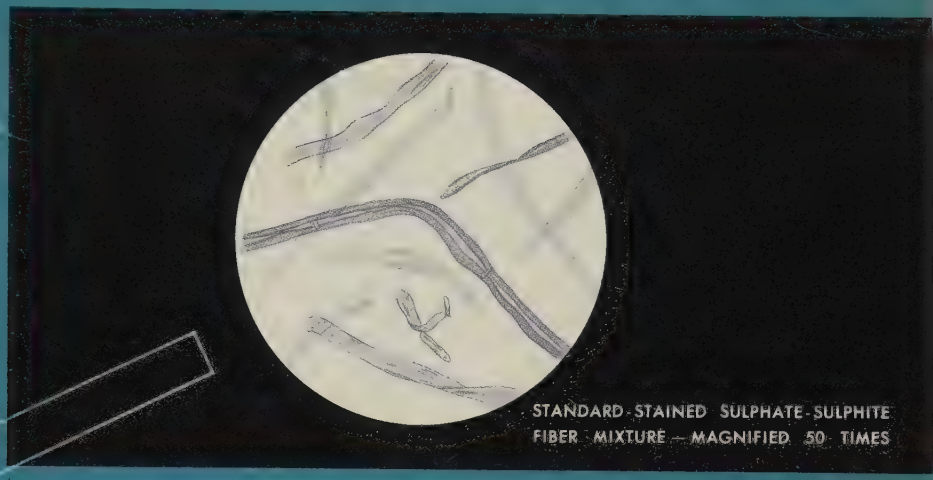

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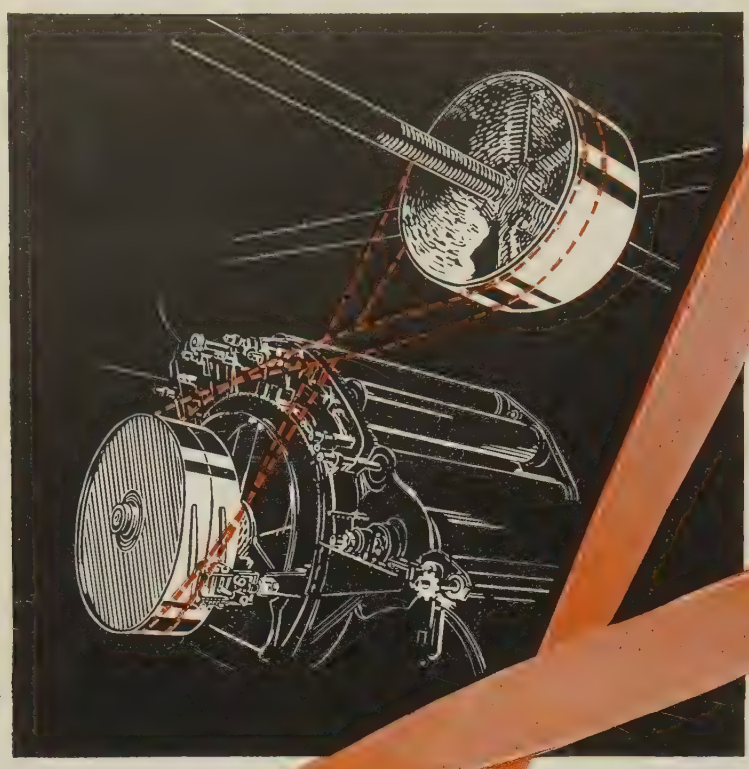

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Pilot Plant Recovery of Heat and Sulphur from Spent Ammonia-Base Sulphite Pulping Liquor

G. V. PALMROSE and J. H. HULL

Operation of a pilot plant at the Lebanon, Ore., mill of the Crown Zellerbach Corp. for studying evaporation and burning of ammonia-base spent liquor with recovery of sulphur from the resultant flue gases has demonstrated the practicability of the process. The pilot plant handled the liquor from 10 tons of pulp per 24 hours. No trouble during evaporation with polymerization of the liquor occurred. Liquor of 50% solids burned very readily in a refractory furnace ahead of a boiler. Burning in a water-wall furnace did not appear practicable. Steam production was over 10,000 pounds per ton of pulp. Sulphur recovery in the absorption system as SO_2 was about 80% of the sulphur in the solids fired to the furnace. Salt in chips from salt water-borne logs caused severe corrosion in the coolers and piping of the gas cooling portion of the absorption system. This was avoided by operation of the cooling tower as a single-pass cooler at the sacrifice of some sulphur recovery. Design of a full-scale plant is discussed.

In December of 1949 Crown Zellerbach Corp. and Soundview Pulp Co. in a cooperative venture, converted the Lebanon, Ore., mill of Crown Zellerbach from dolomite base to ammonia base. The experience on the pulping and bleaching of western woods with ammonia-base acid and on the manufacture of paper from these pulps was presented by LaFond and Holzer (*1*).

The work covered in their paper constituted the first phase of the application of ammonia base to the over-all problem of stream improvement. Pilot planting of the second phase, the evaporation and burning of the spent pulping liquor with recovery of chemicals from the resultant flue gases has now been completed. Pilot plant operation was started on Feb. 26, 1951, and continued 5 days a week until Oct., 1951. This paper describes the pilot plant and summarizes and discusses the results obtained.

DESCRIPTION OF PILOT PLANT

General Designs

The pilot plant was designed to take the liquor from approximately 10 tons of pulp per 24 hours, concentrate it from about 9% solids to 50% solids, burn it under a boiler, and recover sulphur dioxide from the resultant flue gases by scrubbing them with ammonia solution. The resultant ammonium sulphite-bisulphite solution was returned to the acid plant for addition to the raw acid. In a full-scale plant this ammonium sulphite-bisulphite solution would be used to absorb the SO_2 from the burner gas to make "raw" acid.

Figure 1 is a flow sheet of the pilot plant showing the main controllers and principal pieces of equipment. Many of the pipe lines and meters are omitted for purposes of clarity.

Spent Liquor Supply

Liquor from the blow pits drained by gravity to the collection sump. An arrangement of gates at the head of the sump permitted either collection of the liquor or sending it to the sewer. Starting and stopping of the collection were regulated by hand according to the liquor temperature in the line from the blow pits as indicated by a recording thermometer. From the sump the liquor was pumped to a 15,000-gallon storage tank. From there another pump moved it to the evaporator.

Evaporator

The evaporator was a single effect Conkey flat plate heating surface type. All plate materials coming in contact with liquor or vapor were of type 316 ELC alloy stainless steel. It had no condenser and was operated as a falling film evaporator. Two circulating pumps and the related equipment were supplied for employing the Rosenblad channel switching method for control of scaling. It had 2200 square feet of heating surface, a size proportioned to serve as one effect of an eventual multiple effect unit. This was the first large size unit of this type built in this country.

About one half the steam supply came from the mill header and the balance from the pilot plant boiler. Steam flow to the evaporator was regulated by an automatic flow controller.

Liquor feed flow to the evaporator was automatically controlled to maintain a set level of liquor in the vapor head.

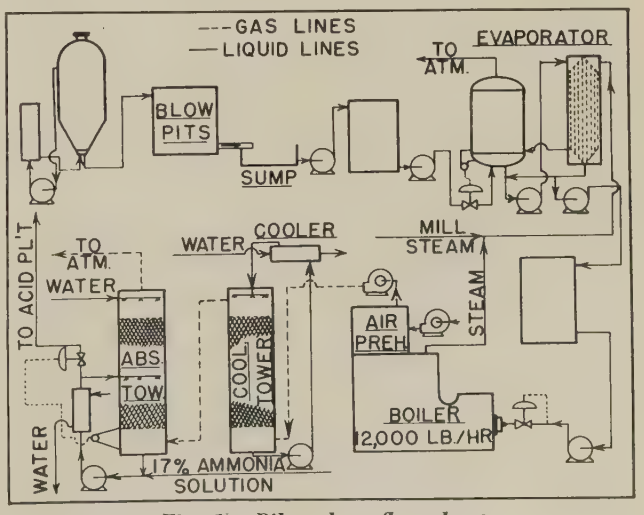

Fig. 1. Pilot plant flow sheet

G. V. Palmrose, Chemical Engineer, Soundview Pulp Div., Scott Paper Co., Everett, Wash. J. H. Hull, Member TAPPI; Manager Process Development, Central Research Dept., Crown Zellerbach Corp., Camas, Wash.

Output was hand regulated according to the solids test and the rate desired. An orifice meter gave a record of the feed flow. Flowmeters on each circulating leg were interlocked with the steam flow controller so that, if liquor circulation over the plates stopped, the steam flow was automatically cut off.

Thermocouples and pressure gages at the inlet and outlet of the two sides of the heater completed the instrumentation.

Combustion Equipment

A 250-gallon storage tank, after the evaporator, held a reserve of concentrated liquor. This acted as a surge tank to take up any variations in evaporator output. A stainless steel high-pressure pump moved the liquor from this tank to the burner.

The steam generating unit in which the liquor was burned was an old water tube unit with a Dutch oven ahead of the boiler. It had been taken off the mill line since it had been limited to 50 p.s.i. and thus was available for pilot plant use. The grates were removed from the Dutch oven and some brickwork added to give a furnace of proper dimensions. This Dutch oven was later removed and the burner mounted directly under the boiler. A forced draft fan, an air preheater, and an induced draft fan were also added with the necessary dampers for combustion control. The induced draft fan was of high enough head to push the flue gases through both the cooling tower and absorption tower.

The burner finally adopted after considerable experimentation was a steam atomizing burner with the liquor on the inside and the steam outside. The liquor discharged through a central opening and the atomizing steam came in through several radial openings at right angles to it.

Liquor flow to the burner was regulated by a flow recorder controller.

Steam production was measured by a recording flowmeter. Other variables measured by instruments were draft at various points, CO_2 in the flue gas, flue gas temperature, air temperature, atomizing steam flow, furnace temperature, and liquor temperature.

Sulphur Recovery Equipment

The sulphur recovery system consisted of a cooling tower and absorption tower with related equipment.

The cooling tower was of wood stave construction, 5 foot inside diameter, containing 24 feet of 3-inch spiral tile, stacked. It was designed to cool the flue gases from the air heater temperature to 104°F. Cooling water was pumped at about 80 g.p.m. from the bottom of the tower through a heat exchanger and then sprayed into the top.

The absorption tower was a 5-foot inside diameter wood stave tower 30 feet high packed with two 5-foot sections of 3-inch spiral title. The absorption solution of ammonium sulphite-bisulphite was circulated over the bottom section and pumped through a heat exchanger after each pass over the packing. The same cooling water was used in the heat exchangers for both the absorption tower and cooling tower. Seventeen per cent ammonia solution was added at the suction side of the recirculation pump. This feed was regulated by a pH recorder controller. Make-up water equivalent to the acid sent to the acid plant was added above the top section. The purpose of adding the water at that point was to recover any ammonia that might be stripped from the scrubbing solution. Provision was made for increasing the height of packing in the tower section to a maximum of 15 feet if necessary. Acid from the tower was taken after the heat exchanger and was regulated by an internal ball float connected to an air-operated control valve. This flow from the tower was also measured and recorded by a recording rotameter.

Water make-up to the tower was set manually. A recording orifice flowmeter recorded the circulation rate of the scrubbing liquor over the packing. Ammonia solution flow to the tower was measured and recorded by a recording rotameter.

Gas and liquor temperatures in and out of the tower were measured and recorded by temperature recorders.

OPERATION OF PILOT PLANT

Schedule of Operation

The plant was operated on liquor from salt-free wood chips and on liquor from chips to which salt had been added. The latter was studied to provide data for Soundview Pulp Co. and one of Crown Zellerbach's sulphite mills that uses salt water-borne logs.

Burning was first carried on using the converted Dutch oven as a furnace ahead of the combustion chamber under the boiler. Later the Dutch oven was removed and the burner mounted in the combustion changer directly beneath the boiler. This was done to determine the feasibility of burning the liquor in a water-wall furnace.

Recovery of Liquor

The liquor supply to the pilot plant was controlled by the evaporator operator, who kept a good inventory of 9% solids liquor. Since only about 20% of the total waste liquor was being processed no special washing procedure was used. The blow pits were operated normally and the strongest liquor taken. Experience showed that the liquor from the blow pits with a temperature above 185°F. would usually contain at least 9% solids.

When simulating operation on salt water-borne wood, 200 pounds of salt was added to the chips by the cooks for each 9.5 tons of pulp.

The Start-Up

The first few weeks of operation were spent in learning how to operate the evaporator and furnace. During that time a procedure for channel switching of the evaporator was set up, a satisfactory burner for the liquor was developed, and better draft controls installed on the boiler. Evaporator operators were also trained during that period. When it was felt that evaporation and burning could be handled routinely, they were put on 24-hour operation and the absorption system started. Before the latter would operate properly, considerable work had to be done on the pH controller. After several changes in the ammonia addition equipment, the system operated in a satisfactory manner.

In general, the problems encountered were normal for starting up a new process.

Evaporator Operation

On starting up, the evaporator was filled with liquor at 9% solids and this was brought to 50% solids as soon as possible. Liquor at the required rate was then drawn off, and the steam flow controller set at the proper rate to give this flow of outgoing liquor. Feed flow was automatically controlled by the level controller.

Channels were switched every 8 hours. The strainers in the product line were switched at the same time, and the dirty strainer cleaned and left ready for the next shift. Channel switching required the shifting of 16 pairs of valves ranging from 16-inch size down to $^1/_4$-inch size. A large number of these valves, however, were instrument valves and would not be necessary in a production unit.

Burning

The burning operation also became routine after some experience. When starting up after a shutdown, the furnace was first fired with oil using an ordinary oil burner. When the furnace temperature reached 2000°-F. or higher, the oil burner was removed, the liquor burner installed, and the liquor turned on. The flow controller was then set at the desired rate and the dampers in the air line set to give as high a value of CO_2 as possible without production of H_2S. The damper in the flue gas line was then set to give a furnace draft as near zero as possible. When collecting data on absorption the CO_2 content of the flue gas was varied. The presence of H_2S could be detected by odor and by the CO_2 meter. The meter was of the gas conductivity type, and, as soon as H_2S appeared in the gas, the indicator immediately dropped toward zero.

Burners were changed every eight hours and the one removed cleaned up and left in readiness for the next shift.

Absorption

To put the absorption system in operation, after burning was satisfactory, water was started circulating through both towers. Then in sequence the flue gas from the boiler was switched to the cooling tower. The ammonia pump to the tower started with the rate set approximately by hand. The pH controller was then set at the desired pH and the system put on automatic control. The water rate to the absorption tower was finally set at the desired figure. Acid was sent to the acid plant as soon as it reached proper strength.

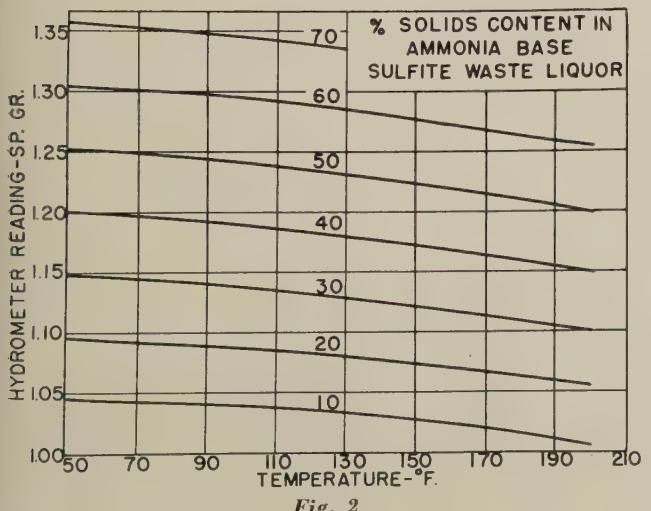

Fig. 2

TESTS AND PROCEDURES

Most of the tests and methods used were standard methods or modifications of them.

Solids content of the liquor was determined by hydrometer and temperature readings. Figure 2 shows the chart used to convert the reading to per cent solids. Occasionally this was checked gravimetrically.

Total and combined SO_2 in the absorption tower acid and the cooling tower water were determined by the Palmrose method.

CO_2 plus SO_2 content of the flue gas was determined by a recording CO_2 meter and checked periodically by an Orsat test.

SO_2 content of the flue gas was determined periodically by the Reich test.

SO_3 content and salt content of the absorption tower exhaust gas was determined by drawing a metered volume of gas through a water absorption train and analyzing the scrubbing water.

Sulphur, ammonia, and chloride content of the cooling tower waste were checked occasionally in the laboratory by standard analytical methods.

Sulphur content of the weak and concentrated liquor was determined weekly by a standard analytical method.

Sulphates in the cooling tower waste and absorption tower acid were determined hourly using a turbidimetric technique.

RESULTS OF OPERATION

Liquor Recovery

Blow pit washing tests indicate that it may be possible to recover as much as 80% of the spent liquor without too great a dilution for evaporation, if the blow pits are padded with strong spent liquor and a weak liquor used as the first wash.

This would apply only to the Lebanon mill. Other mills with different blow pits and drainage systems might obtain less favorable results.

Solids per Ton of Pulp

Measurements of total solids in the liquor gave a figure of 2440 pounds per ton of pulp. At 80% recovery, solids recovered would be 1952 pounds per ton. This is the figure used in computing steam and sulphur recovery on a pulp tonnage basis. Again this figure applies only to this mill.

Evaporation

Laboratory work before start-up had indicated that liquor above 50% solids would polymerize if kept at a high temperature for any length of time. This never materialized in the operation but extreme care was used to safeguard against it. Liquor of 55% solids stored for 2 weeks became so thick that it could barely be pumped, even when heated nearly to the boiling point. However, operation of the evaporator on 50% solids liquor with 10 p.s.i. on the vapor head did not give any trouble.

Weekly inspection of the evaporator plates showed that there was definitely scale formation. Analysis indicated that it was largely calcium sulphate. Channel

switching every 8 hours with continuous circulation of condensate served to control the scale. Heat transfer coefficients started as high as 350°F and gradually dropped to about 220°F. This downward trend halted when continuous condensate circulation was started. The solids loss through the evaporator was about 1.5%. This corresponded to the amount lost in channel switching and sampling.

There was a sulphur loss of about 8% in evaporation. This was due to volatilization of the free and loosely combined SO_2 in the feed liquor and to the sulphur content in the solids lost in sampling and channel switching.

The average evaporation efficiency over a 10-week period was 0.888 pound of water evaporated per pound of steam.

Combustion

After the proper type burner had been developed, and with the converted Dutch oven furnace in front of the combustion chamber, no difficulty with burning the liquor was experienced. With good atomization the liquor gave a fire that handled almost like an oil fire. When the boiler and air heater were clean, combustion was very complete. The furnace temperature was usually brought to 2000°F. before starting the liquor but at times it was started as low as 1500°F. From there it would climb to the range of 2000 to 2400° depending on the firing rate.

It was possible to burn liquor as low as 40% solids for several hours at a time. In fact, accidentally, liquor of 35% solids was fired for a short time without blacking out the furnace.

Steam generation on 50% solids liquor averaged about 5.3 pounds of steam per pound of solids fired. One pound of steam being equivalent to 1018 B.t.u. Based on a calorific fuel value of 9000 B.t.u. per pound of solids, boiler efficiency was 65%. The boiler and air heater had to be air lanced at least once a week to avoid excessive draft loss.

After it had been established that good combustion of the liquor, with no auxiliary fuel, could be maintained in a refractory furnace, the Dutch oven was removed and the burner mounted in the combustion chamber directly under the boiler. This was done to determine if the liquor could be burned in a water-wall furnace. Actually this was not a full water-wall furnace since only the ceiling had water tubes in it.

Combustion under this condition was definitely poor and very hard to maintain. Starting with a cold boiler the unit had to be fired on oil about 16 hours before a liquor fire would support itself. Combustion was never complete and considerable amounts of black soot deposited on the boiler tubes and carried over into the absorption system.

This black dust presented a definite explosion hazard. When the boiler was air lanced, immediately after shutdown, the dust would burst into flame as soon as the air hit the hot tubes. In the combustion chamber under the boiler a small amount of the dust would collect on the floor and explode whenever an inspection door was opened.

Boiler efficiency showed a definite improvement when operating without the Dutch oven. Steam production went to 5.6 pounds of steam per pound of solids fired, giving a boiler efficiency of about 73%. This, however, was due to elimination of radiation loss from the refractory furnace; not to improved combustion.

Table I. Combustion With and Without Refractory Furnace

	With refractory furnace	*Without refractory furnace*
Tonnage rate through furnace per 24 hr.	10.3	11.6
Steam generated, lb.	119,500	144,410
Pounds steam per pound solids	5.3	5.66
Pounds steam per ton of pulp	11,600	12,500

Table I summarizes the burning operation with and without the refractory furnace. When burning liquor from salt-free chips the ash build-up on the tubes was fluffy and fairly easy to remove.

ABSORPTION SYSTEM

Cooling Tower

The cooling tower was designed to cool the gases from about 400 to 104°F. with cooling water circulation over the packing at a rate of about 90 g.p.m. The heat pickup of the cooling water was removed by a heat exchanger. The only effluent from the cooling tower was about 1 g.p.m. water condensate from the flue gases. When the tower was operated under these conditions the pH of the circulating water was 2.5 to 3.0. This low pH was due to the presence of a small amount of sulphuric acid in the cooling water which had been scrubbed from the flue gases. Fortunately there was always a trace of ammonia in the liquor which was enough to keep the pH of the cooling water high enough to prevent any serious corrosion. Although there was evidence of some corrosion test samples indicated that 316 alloy stainless steel should give adequate equipment life.

Absorption Tower

The absorption tower was designed to recover 98% of the SO_2 in 2400 c.f.m. of flue gas entering at 104°F. The flue gas contained 0.5 to 0.7% SO_2 by volume. The tower was packed with tile to the exact height the design figures specified. No safety factor was provided, but space was left in the tower for doubling or tripling the height of packing if this original height was found inadequate. This additional height was never added. Sulphur recovery based on gas analysis tests was over 99%. This high recovery was possible because of the alkaline nature of the scrubbing solution. Occasionally, when the pH controller was not functioning properly, the odor of SO_2 could be detected in the gas from the tower. Most of the time, however, the concentration was below the threshold value.

The pH of the tower effluent liquor was controlled initially at 6.5, later this was lowered to 6.25. The lower figure resulted in a usage of about 85 pounds of ammonia per ton of pulp. Strength of the recovered acid was regulated by the amount of water added to the absorption tower. Total SO_2 varied from about 2.50 to 3.50 and combined SO_2 from about 1.30 to 2.00. These figures are in percentage SO_2 as in the regular mill test.

Sulphates in the recovered acid amounted to 4 to 5% of the sulphur to the furnace. They varied from 0.10 to 0.60, expressed as percentage SO_2 in the recovered acid.

Formation of sulphates in a system like this is dependent on three things: the oxygen content of the flue gas, the temperature of absorption, and the height of packing.

The packing was kept to a minimum to avoid longer than necessary contact of the flue gas with the scrubbing liquor. Too long a contact would result in absorption of the oxygen from the flue gas and oxidation of SO_2 to SO_3. The CO_2 content of the flue gas, which is an inverse measure of the oxygen content, should be kept as high as possible. This cuts down the amount of oxygen available for oxidation of SO_2 to SO_3 both in the gas phase and liquid phase. Increasing absorption temperature increases sulphate formation even though oxygen is less soluble at higher temperatures. This is brought about by increasing the reaction rate between oxygen and SO_2 and decreasing the viscosity of the absorbing liquor. Decreasing the viscosity increases the turbulence of flow over the packing, which in turn results in faster absorption of oxygen by the absorbing liquor.

Figure 3 illustrates the effect of absorption temperature and CO_2 content of the flue gas on the formation of sulphates. Note that all the lines tend to cross at about 16.5% CO_2. Below that figure sulphate formation at any one CO_2 content increases with increasing temperature. In that area the reaction rate between the dissolved oxygen and the SO_2 is the controlling factor. Above 16.5% CO_2 sulphate formation decreases with increasing temperature. In that area the decreasing solubility of oxygen plus the lower amount in the flue gases controls the sulphate formation.

However, operating a full-scale absorption system in these upper temperature ranges would not be practical because this absorbing liquor is also used to absorb SO_2 in both the recovery system and in the acid plant. Passing it through a heat exchanger might be a solution, but this adds another piece of equipment.

Heat recovery by the coolers in the absorption system amounted to 4520 pounds of steam per ton of pulp. This was recovered as hot water ranging in temperature from 120 to 140°F.

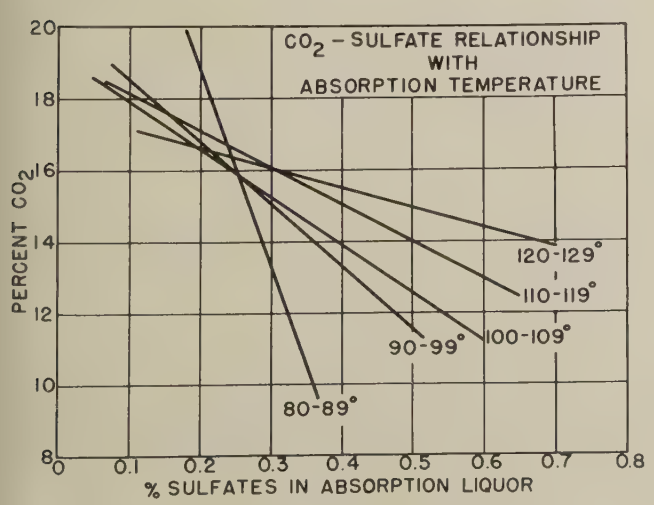

Fig. 3

EFFECT OF SALT IN THE CHIPS

Operation of the plant on liquor from chips to which salt had been added was undertaken to simulate liquor from salt water-borne logs.

No difference in evaporation was apparent and no corrosion was indicated.

Burning of the liquor, however, gave an ash that was sticky, hard to remove, and built up at a high rate on the boiler tubes. This ash, however, could be removed by vigorous lancing.

The real difficulty appeared in the cooling tower. As soon as salt was added to the chips definite signs of corrosion appeared in the cooling tower system. In a matter of a few days pumps, valves, and pipe lines began leaking. The pH of the circulating liquor dropped to less than 1.5. Analysis showed the cooling water to contain appreciable amounts of hydrochloric acid along with a small amount of sulphuric acid.

Table II. Absorption With and Without Recirculation of Cooling Water

	With recirculation	*Without recirculation*
Sulphur to furnace, lb.	1175	1290
Recovered as SO_2, lb.	1035	840
Recovered as sulphate, lb.	67	62
Lost in cooling tower waste, lb.	...	58
Per cent as SO_2	88.0	65.1
Per cent as sulphate	5.7	4.8
Per cent as cooling tower waste	...	4.5
Sulphur as SO_2 recovered per ton of pulp, lb.	126	93

After the severe corrosion appeared the cooling tower was operated single pass. Water was put into the top of the tower and sent to the sewer after one pass over the packing. The amount of water was kept to a minimum to prevent too great a loss of sulphur.

This procedure eliminated the corrosion problem, but introduced a loss of SO_2 and eliminated the possibility of any heat recovery at that point.

A salt balance indicated that about 70% of the salt in the liquor to the furnace was removed in the cooling tower, 10% was removed in the absorption tower, and 5% went to the atmosphere. A small amount was in the boiler dust and the balance of 10 to 15% was unaccounted for.

Table II summarizes the figures for the absorption system when operating with and without salt addition to the chips. The lower recovery when operating with salt addition was due to the sulphur lost in the cooling tower effluent caused by operating this tower single pass. The salt addition had no effect on the operation of the absorption tower.

FULL-SCALE DESIGN

The data and experience obtained in operating this pilot plant should make it fairly easy to design a full-scale system. Just how elaborate a system to install will depend on several factors.

If blow pit washing will give enough liquor recovery to satisfy requirements there is no point in going to the extra expense of vacuum washers.

The number of effects in the evaporator will depend on steam cost and steam available. With either a four- or five-effect unit burning of the liquor should give

enough steam to operate both the evaporator and pulp mill.

Whether to use the plate-type evaporator or a tubular one will depend partly on individual preference and partly on economic considerations. For a 7-day week operation a spare heater would probably be required if tubular heaters were chosen.

If the mill is fortunate enough to have excess boiler capacity equivalent to the evaporator steam load no new boiler capacity need be added. Conversion of a regular hogged fuel unit to an ammonia-base liquor furnace is fairly simple since only the Dutch oven need be modified. Tube fouling can be minimized by good soot blowers.

The absorption system does not involve any towers of very great height. Their operation is fairly simple and easy to control. The main item of expense in the absorption system would be the heat exchangers required. Sulphur recovery as useful sulphur in this system should be about 85 to 90% of the combined sulphur in the cooking acid. This would probably vary from 125 to 150 pounds of sulphur per ton of pulp depending on the combined SO_2 used in cooking. For mills using salt water-borne logs this figure would be lower. Additional sulphur could also be recovered in the evaporator vent gases. A mill that had installed a blow gas recovery system plus the system described here should be able to operate on well under 100 pounds of sulphur per ton of pulp.

OPERATING PERSONNEL

Supervisory and chemical engineering personnel was supplied jointly by the two companies. There was one chemical engineer on shift who operated the furnace and absorption system and supervised the evaporator operation. Evaporator operators were men drawn from the mill labor pool and trained after the evaporator was put in operation. There was one instrument engineer on the day shift only who kept the 32 instruments in repair, built new ones, and did any other maintenance work required.

SUMMARY

Operation of a pilot plant at the Lebanon mill for the evaporation and burning of spent ammonia-base liquor demonstrated the feasibility of the process. There was some scale deposited during evaporation but the Rosenblad channel switching system minimized it. The 50% solids liquor burned very well and combustion was easy to control. Steam production was well over 10,000 pounds per ton of pulp production. Sulphur recovery from the flue gases amounted to about half that usually lost in the blow gases and waste liquor. The presence of salt in the pulpwood caused corrosion in the flue gas cooling system ahead of the absorption tower. Design of a full-scale evaporator system would involve consideration of steam costs against capital charges. Furnace design is simple. For some mills it would only involve conversion of an existing boiler. The absorption system involves no extremely high towers. At present equipment is on order to provide full-scale evaporation and burning at Lebanon.

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Pinitol from Sugar Pine

Pinus lambertiana Dougl.

ARTHUR B. ANDERSON

It has been found that sugar pine heartwood contains from 1.3 to 9.5% pinitol, the average being 4%. The larger quantities of this cyclitol are found in the butt heartwood. The sapwood contains from traces to 0.5% pinitol. It is estimated that 6,000,000 pounds of pinitol is potentially available from sugar pine mill waste produced annually in California. The product is readily recovered from the wood by water extraction and subsequent concentration of the aqueous extract. This simple and economical process may offer a new utilization outlet for sugar pine mill wood waste, which now, in the main, is burned. Pilot plant studies and market research surveys are the next steps to establish the over-all economics of such a process. The position of the methyl group in pinitol had not been ascertained. It has now been found that pinitol readily reacts with acetone to form a diacetone compound which establishes the position of the methyl group.

The University of California has just recently established a Forest Products Laboratory in conjunction with its School of Forestry. The initial research projects undertaken in this laboratory are concerned with wood chemistry, in particular, to ascertain the nature of the extractive components present in the various wood species in California. Such studies would not only extend over relatively meager knowledge of the nature and function of extractive chemical components in wood, but would also evaluate various wood wastes, as well as noncommercial wood species, as potential sources of chemical products.

Sugar pine (*Pinus lambertiana* Dougl.) is among the various wood species presently under investigation. This commercial timber species is found, largely, in California and extends into southern Oregon. The average annual production of sugar pine lumber in the United States for the 5-year period 1945–49 was about 322,000,000 board feet, of which approximately 263,500,000 board feet or about 80% of the total, is produced in California.* It is estimated that approxi-

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* Bureau of Census.

mately 54% of a pine log is recovered as lumber, leaving 46% as by-product or approximately 80 cubic feet of waste per M feet log scale processed (*17*). Thus, the total amount of by-product produced in the sugar pine mills in California amounts to approximately 21,000,000 cubic feet or about 460,000,000 pounds of dry material, including bark and wood, annually. In the main, this material is now burned, either for mill and domestic fuels or disposed of in wood waste burners.

A proximate analysis of a representative sample of sugar pine several years ago, indicated that the heartwood, in particular, was relatively rich in water-soluble components (8.4% cold water and 10.3% hot water soluble), while quite low in resinous constituents (4.3% ethyl ether soluble)(*1*). While that investigation was under way, random pieces of sugar pine heartwood lumber were extracted and found to contain surprisingly large quantities of pinitol, amounting up to as much as 8%, based on the dry weight of the wood. This prompted the present investigation, namely, to determine the distribution and amount of pinitol in sugar pine logs, to ascertain whether this wood contained sufficient amounts of this chemical product to warrant the possible utilization of sugar pine mill waste as a potential commercial source for this cyclitol, which is a monomethyl ether of *d*-inositol. This study is confined to heartwood and sapwood since a previous report by Kurth, Hubbard, and Humphrey indicated that sugar pine bark does not contain pinitol (*11*).

It was nearly a hundred years ago that Berthelot first described the chemical nature of a pine tree "sugar" obtained from the exudate of sugar pine (*3*). Wiley later identified this product as pinite, now called pinitol (*18*). This cyclitol is present in redwood heartwood (*Sequoia sempervirens* (D. Don) Endl.) (*15*) and more recently it has been found in the heartwood of five other pines belonging to the *Haploxylon* subgroup or soft, white five-needled pines (*12*). The yields of pinitol from these various sources are reported to vary from traces to 0.5%. These yields fall far short of the amount of pinitol indicated to be present in sugar pine.

METHOD OF SAMPLING

In determining the distribution of pinitol in sugar pine, three trees from each of two sites were sampled. These were prepared by taking 6-inch wide cross sections from the large end of the merchantable logs from each tree. The three trees from Martell, Calif., were mature, ranging from 135 to 170 feet in height, 55 to 72 inches D.B.H., and annual ring counts (butt disk) of 327 to 617. Four 32-foot logs were cut from each of these trees, and the cross sections for samples were cut from the large end of the butt, third, and fourth 32-foot logs, giving cross-section samples at 1, 65, and 97-feet heights, respectively. The second set of three sugar pine trees was obtained near Stirling City, Calif. These were younger trees, all being about 35 inches D.B.H., and with annual ring counts from 170 to 214. Three 32-foot logs were cut from each, and cross sections taken from the large end of the three 32-foot logs, giving samples at 1, 33, and 65 feet, respectively.

A 6-inch wide section was cut through the diameter of each disk, and the heartwood and sapwood segregated into inner, intermediate, and outer portions giving six radial samples from the pith to the cambium. After the wood was chipped, it was air dried, then ground in a Wiley mill to pass a 2-mm. screen. The ground samples were stored in Mason jars.

COLD-WATER EXTRACT

It was found that pinitol could be quantitatively removed from sawdust, merely by cold water extraction. Thus, the amount of cold-water soluble would be indicative of the amount of pinitol plus other water-soluble components present in sugar pine. The distribution of cold-water solubles (*4*) in the trees sampled are given in Table I.

As can be observed from the table, the largest quantity of water solubles occurs at the butt heartwood and decreases to what appears to be a minimum at the middle with a slight rise toward the top heartwood. In the case of sapwood, which contains much less water solubles than the heartwood, there seems to be slightly more water solubles at the top of the tree than at the bottom. The radial distribution in the butt heartwood appears to reach a maximum in the intermediate or center, while in the middle heartwood, the water solubles gradually increase upon approaching the sapwood. In the top, the water solubles appear to reach a minimum in the intermediate heartwood area. In the case of the sapwood, the variation in water-soluble content, on the whole, is so slight that no definite pattern of distribution appears discernible. In most instances, the water solubles seem to increase toward the inner sapwood. The more immature trees (SP-7, 8, 9) appear to contain slightly more total water solubles than the older trees.

DISTRIBUTION AND AMOUNT OF PINITOL

The determination of the amount of pinitol present in each of the heartwood samples was carried out by adding 800 ml. of water to 50 grams of sawdust in a liter flask and gently agitating this mixture by bubbling air through it for 3 hours at room temperature. This period was ample to remove all the pinitol since further extraction, either by cold or hot water, produced no recoverable pinitol. After the 3-hour extraction period, the solution was filtered with suction and the extracted sawdust washed with several portions of water totaling 500 ml. The total filtrate was boiled down to about 100 ml., and then transferred to an evaporating dish, placed on a steam bath, and allowed to come to a heavy syrup, which, in many instances, began to crystallize. Ten milliliters acetone was added to the warm syrup and stirred; and the precipitate, which readily formed, was set aside for 1 hour. The material was filtered with suction onto a tared, sintered glass funnel, and washed with 10 ml. acetone, leaving a light tan gray solid material. This was dried in a 60°C. vacuum oven, cooled in a desiccator, weighed, and the amount of crude pinitol determined. The amount of pure pinitol present in these precipitates averaged about 85%, if based on methoxyl content, assuming the absence of other methoxyl containing components. Theory for pinitol: 15.98% methoxyl, found 13.42 to 13.74% methoxyl or 84 to 86% as pinitol. The melting point of the crude product varied from 164 to 172°C., and it had an average $[\alpha]_D^{22}$ + 58.6 (*c.* 1.0% in

Table I. Cold-Water Soluble, Per Cent Dry Basis

	Heartwood			Sapwood		
	Inner	*Intermediate*	*Outer*	*Inner*	*Intermediate*	*Outer*
		Tree SP-1, D.I.B.[a] 55.5 In., 413 Yr., 15 R/In.				
Top	8.4	3.8	4.4	3.0	2.1	2.2
Middle	3.5	3.6	3.5	1.6	2.2	2.4
Butt	9.8	10.0	6.6	1.6	1.2	1.3
		Tree SP-2, D.I.B. 65.0 In., 617 Yr., 18 R/In.				
Top	4.1	4.3	8.8	2.9	1.3	1.8
Middle	3.7	5.2	7.0	3.4	1.9	2.1
Butt	4.8	8.5	6.3	1.1	2.1	2.0
		Tree SP-3, D.I.B. 54.2 In., 327 Yr., 12 R/In.				
Top	4.5	3.3	4.0	3.1	1.8	1.9
Middle	2.8	3.3	3.9	2.5	1.6	1.7
Butt	6.2	9.2	8.2	2.9	1.6	1.6
		Tree SP-7, D.I.B. 37.7 In., 169 Yr., 9 R/In.				
Top	6.7	4.5	6.6	4.2	2.1	1.9
Middle	5.5	6.0	6.7	3.4	2.4	2.3
Butt	10.1	11.2	10.2	2.8	1.9	1.4
		Tree SP-8, D.I.B. 36.0 In., 214 Yr., 12 R/In.				
Top	5.2	3.5	3.8	1.4	1.8	2.5
Middle	3.8	3.1	4.6	1.6	2.0	2.4
Butt	10.8	9.7	8.3	3.4	2.1	2.0
		Tree SP-9, D.I.B. 36.2 In., 176 Yr., 9 R/In.				
Top	6.1	6.3	6.4	3.3	2.2	2.3
Middle	5.4	4.9	6.2	1.6	1.4	1.3
Butt	8.5	8.6	7.2	1.8	1.9	2.7

Trees SP-1, 2, and 3: Martell, Calif.
Trees SP-7, 8, and 9: Stirling City, Calif.
[a] Butt disk.

water). The crude product contained some reducing substances, since it reacted with Fehling solution, and it also contained pentose-producing components, since distillation with 12% HCl produced a phloroglucide amounting to 2.5 to 3.0%, calculated as arabinose. Partition chromatography of the crude pinitol and the resulting mother liquor indicated the presence of at least four other substances, one of which is known to be another cyclitol (carried out by C. Ballou). These components are under investigation and will be subsequently reported.

A number of solvents were tried as crystallizing media—for quantitatively precipitating the pinitol from the syrups produced. Acetone, absolute ethanol, 95% ethanol, absolute methanol, and glacial acetic acid were used, and in each case acetone gave the largest recovery of precipitate, and the highest recovery of pinitol based on methoxyl determinations. This was likewise demonstrated when pure pinitol was recovered from its syrup and using these various solvents as crystallizing media. In the case of acetone 97 to 99% of the pinitol was recoverable from the syrups. On partition chromatography of the acetone, mother liquors and subsequent spraying with ammoniacal silver nitrate solution, at best, a very faint spot appeared at the pinitol region, while all other mother liquors produced a definite spot at the pinitol region.

The distribution and amount of crude pinitol (i.e., 85% pinitol) recovered from the various heartwood samples are reported in Table II.

As indicated by the amount of water solubles in Table I, the largest quantity of pinitol occurs in the butt heartwood, with smaller amounts at the middle and top sections. It will be observed that in the radial distribution in the butt heartwood of immature trees (SP-7, 8, and 9), the pinitol content appears to be the greatest in the inner portion, gradually decreasing toward the outer heartwood. However, the intermediate butt heartwood seems to contain the largest amount of pinitol in the mature trees. In the middle portion of the trees, slightly larger amounts appear at the outer heartwood, while in the top the least amount occurs in the intermediate area of the heartwood region. While the pattern of distribution of pinitol found in the middle and top portions of the tree appears to be comparable, the butt heartwood of the more immature trees seems to contain more pinitol than the mature trees, particularly in the outer heartwood.

It will be observed that the inner butt heartwood of trees SP-2 and 3 contains considerably less pinitol than similar areas in the other four trees examined. Upon visual examination of these areas, it was noted that SP-2 and SP-3 butt heartwood sections contained what appeared to be incipient decay, while the other butt sections were sound. Perhaps decay may account for these lower quantities of pinitol in these particular areas, a portion of the pinitol being destroyed or translocated. It will also be noted that the inner top heartwood of tree SP-1 and the outer top heartwood of tree SP-2 contain what appears to be relatively large amounts of pinitol, when compared to similar locations in the other trees examined. Since sugar pine trees, which have been wounded through some natural cause, produce an exudate high in pinitol content, it may be possible that the heavy deposition of pinitol in these areas was caused by some injury, such as lightning or heavy winds, which upset the normal physiological processes and produced pinitol in excess. These observations are, admittedly, purely speculative, but it is hoped that present studies now under way will throw more light on this matter.

Erdtman indicated that pinitol is possibly a true heartwood substance, for he was unable to isolate it from the sapwood of *Pinus strobus*, which contained 0.3% pinitol in the heartwood (*7*). In the present study, the total nonvolatile cold-water solubles from

sugar pine sapwood contained 5.75 to 6.16% methoxyl or about 36 to 38%, if calculated as pinitol. Partition chromatography of this material clearly indicated that pinitol was present. Attempts to isolate pinitol from sapwood by the procedure described for heartwood failed, resulting only in the precipitation of gummy material, which would not crystallize. So the procedure of isolation was modified by taking up the total water solubles from 500 grams of sapwood in 75 ml. of water and adding 75 ml. of saturated barium hydroxide solution, which precipitated the gums. The barium precipitate was removed by centrifuging and the resulting clear solution carbonated and the barium carbonate removed. The light yellow solution was decolorized with charcoal and evaporated to a syrup on a steam bath. On adding several volumes of 95% ethanol and allowing to stand overnight, in the icebox, a white crystalline product was obtained (2.65 grams or 0.5% yield) m.p. 176–180°C. This was recrystallized from glacial acetic acid and then 95% ethanol, the final product having m.p. 184–186°C., $[\alpha]_D^{22}$ + 66.1 (*c.* 1% in H_2O). A mixed melting point with pinitol isolated from heartwood showed no depression. While it is apparent that pinitol is essentially a chemical deposited in the transformation of the sapwood to heartwood, at least traces of pinitol appear to be present in the sapwood.

PURIFICATION OF PINITOL AND PREPARATION OF DERIVATIVES†

There are several ways in which pure pinitol can be produced from the crude product. One method used was to dissolve the crude pinitol in 10 parts of water and add 5 parts of a saturated solution of barium hydroxide plus 10 parts ethanol to precipitate the gums. This solution was centrifuged or filtered and the solution acidified to Congo red with dilute sulphuric acid to remove excess barium. The barium sulphate was removed by centrifuging, the solution decolorized with charcoal, and the resulting clear, colorless solution partially concentrated on a water bath under reduced pressure. The concentrate was transferred to an evaporating dish and evaporated to a syrup and glacial acetic acid added to crystallize the pinitol in the form of fine white crystals, m.p. 182–184°C. Subsequent recrystallization from water and ethanol produced a pure product, 75% recovery, without working up mother liquors m.p. 184–186°C., $[\alpha]_D^{22}$ + 66.1 (*c.* 1% in H_2O). (Previous values reported, m.p. 185°, $[\alpha]_D$ + 65.4 (*15*); m.p. 184–185°, + 67.7 (*7*); m.p. 186°, $[(\alpha]_D$ + 65.3 (*10*).)

Anal.: Calcd. for $C_6H_6{\cdot}(OH)_5{\cdot}OCH_3$ (194.2): C, 43.29; H, 7.26; OCH_3, 15.98; OH, 43.79. Found: C, 43.08; H, 7.32; OCH_3, 15.83; OH, 43.35.

D-Inositol. Pinitol (3.0 grams) was added to 15 ml. of concentrated HI acid and refluxed in water bath for 2 hours. This was poured into 8 volumes of hot absolute ethanol and crystallization set in on cooling. This was filtered and washed with 95% ethanol, absolute ethanol, and precipitate dried in 60°C. vacuum oven. Yield 2.71 grams. (96.4%), m.p. 237–240°C. Recrystallized from hot dilute ethanol, m.p. 246–247°C. $[\alpha]_D^{22}$ = + 64.9 (*c.* 1% in H_2O). (Previous values, m.p. 246°, $[\alpha]_D$ + 65 (*18*).)

Anal.: Calcd. for $C_6H_{12}O_6$ (180.15): C, 40.00; H, 6.71. Found: C, 39.89; H, 6.72.

Pentacetyl Pinitol. Pinitol (5.0 grams) was refluxed on a water bath for 2 hours with 25 ml. acetic anhydride and 2.0 grams anhydrous sodium acetate. The warm solution was poured with stirring into 150 ml. ice water and the insoluble oil soon crystallized. This was filtered, washed with water, and dried in vacuum oven at 60°C. Yield 8.92 grams (79%), m.p. 93–94°C. Recrystallized from dilute ethanol, m.p. 98–99°C, $[\alpha]_D^{21}$ + 11.3 (*c.* 1% in ethanol) (m.p. 98°, $[\alpha]_D$ + 8.6° (*13*)).

Anal.: Calcd. for $C_6H_6(O_2C_2H_3)_5{\cdot}OCH_3$(404.36): C, 50.49; H, 5.98. Found: C, 50.25; H, 5.83.

Diacetone Pinitol and Pinitol Structure. Pinitol (6.5 grams) was shaken for 8 hours on a mechanical shaker with 250 ml. acetone containing 5.5 ml. concentrated sulphuric acid. The light yellow solution was neutralized with an excess of anhydrous sodium carbonate, filtered, and the insoluble salts washed with dry acetone. The solution was concentrated under reduced pressure, the residue taken up in a small volume of acetone, and the small amount of insoluble material (unreacted pinitol) removed by filtration. The acetone was removed under reduced pressure and the crystalline residue dried in a vacuum desiccator over sodium hydroxide and concentrated sulphuric acid. Yield 6.50 grams (71%), m.p. 98–99°C. The product was sublimed, m.p. 103–105°C., $[\alpha]_D^{22}$ − 45.1 (*c.* 1.9 U.S.P. chloroform).

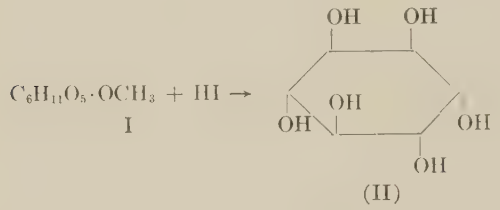
Table II. Crude Pinitol in Heartwood, Per Cent Dry Basis

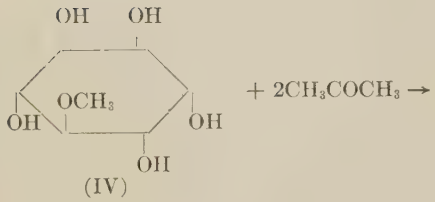
	Inner	*Intermediate*	*Outer*	*Average yield*
Tree SP-1, D.I.B. 55½ In., 413 Yr., 15 R/In.				
Top	7.2	2.3	2.7	4.1
Middle	2.3	2.2	2.0	2.2
Butt	8.7	7.3	4.5	6.8
				4.4
Tree SP-2, D.I.B. 65 In., 617 Yr., 18 R/In.				
Top	3.7	2.1	7.0	4.3
Middle	2.7	2.9	5.3	3.6
Butt	3.6	7.0	3.7	4.8
				4.2
Tree SP-3, D.I.B. 54 In., 327 Yr., 12 R/In.				
Top	2.5	1.5	2.0	2.0
Middle	2.1	1.5	2.0	1.9
Butt	4.2	6.4	4.8	5.1
				3.0
Tree SP-7, D.I.B. 37¾ In., 169 Yr., 9 R/In.				
Top	4.7	1.7	3.3	3.2
Middle	4.1	4.1	4.9	4.4
Butt	9.5	8.6	7.6	8.6
				5.4
Tree SP-8, D.I.B. 36 In., 214 Yr., 12 R/In.				
Top	2.7	1.4	1.3	1.8
Middle	1.7	1.8	2.2	1.9
Butt	8.8	8.6	5.9	7.8
				3.8
Tree SP-9, D.I.B. 36 In., 176 Yr. 9 R/In.				
Top	2.6	2.4	3.7	2.9
Middle	2.5	3.0	4.3	3.3
Butt	6.2	6.7	7.2	6.7
				4.3

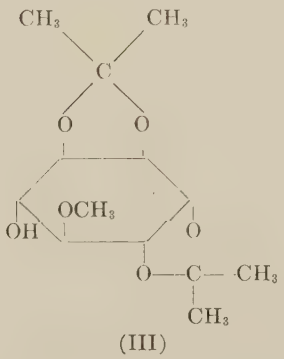
† All melting points uncorrected taken on Fisher melting point block; microanalysis by Microchemical Laboratory, University of California

Anal.: Calcd. for $C_{13}H_{22}O_6$ (274.3): C, 56.92; H, 8.09; acetone, 42.35. Found: C, 56.81; H, 7.97; acetone, 42.5 (acetone determination by D. L. MacDonald).

The configuration of *d*-inositol, the product obtained by demethylation of pinitol (I) has been determined by Posternak to be (II) (*14*) but the position of the methyl







group in pinitol had not been determined. Since pinitol readily reacts with acetone to form a diacetone derivative (III), this would indicate that the methyl group was not on either of the two pairs of vicinal cis-hydroxyl groups (*8*). Thus the methyl group must be attached to one of the two remaining equivalent hydroxyl groups (IV). Further proof of this structure for pinitol is the subject of another paper. (See Anderson, MacDonald, and Fischer, *J. Am. Chem Soc.* in press.)

SUGAR PINE MILL WASTE AS POTENTIAL SOURCE OF PINITOL

Based on the amount of crude pinitol obtained from the wood samples analyzed, it is interesting to speculate on how much pinitol is potentially available from the sugar pine mill waste produced annually in California. It has been estimated that approximately 80.76 cubic feet of waste results from each 1000 feet (log scale) of pine logs milled into lumber (*17*). This total includes 23.30 cubic feet of bark and 18.73 cubic feet of slabs and edgings, consisting largely of sapwood, which contains so little pinitol that it should not be extracted. This leaves approximately 38.7 cubic feet or 850 pounds of dry wood waste consisting of sawdust, shavings, mill trim, and planer ends (*17*), which would be the most suitable for pinitol extraction. This waste is estimated to contain about 75% heartwood or about 600 pounds of dry heartwood waste that would be available from each 1000 board feet of lumber produced. Based on 4% yields of pinitol from heartwood, the heartwood waste from 250,000,000 board feet of sugar pine lumber, if extracted, would yield approximately 6,000,000 pounds of crude pinitol annually.

The only other cyclitol now commercially available is meso-inositol, obtained from corn products steep liquors (*2*). While a number of uses have been proposed for meso-inositol, some of these developments appear to have been curtailed, because of the relatively high cost of the product, which is unlikely to be reduced until its production can be divorced from steep-water extraction (*5*). It is possible that pinitol or its readily produced derivative, *d*-inositol, could replace meso-inositol in some of its proposed uses. In any case, the over-all economics for the production of pinitol from sugar pine wood waste will not be known until pilot plant and market research surveys have been completed.

BIOCHEMISTRY OF CYCLITOLS

Considerable biological interest, mainly the vitamin-like properties, has been centered upon the cyclitols, in particular, meso-inositol (*6*). While the isomers of inositol are reported not to exhibit any biological action, H. O. L. Fischer has reported upon the interesting possibility that naturally occurring hexoses could be interconverted through the medium of the cyclitols and likewise be intermediate between carbohydrates and aromatic substances (*9*). It is too early to speculate what role pinitol and its isomers play in the biochemistry of the tree, but perhaps subsequent studies now being carried out on the extractive components in sugar pine and other wood species will produce evidence as to the function of cyclitols in trees. In passing, it may be interesting to observe here that redwood (*Sequoia sempervirens*) (*15*, *16*) which is among the world's tallest wood species, and sugar pines, the largest of the pines, contain cyclitols.

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The author is grateful to H. O. L. Fischer, D. L. MacDonald, and C. Ballou for their interest and helpful Discussions. Appreciation is expressed to Diamond Match Co., Stirling City Calif.; and Winton Lumber Co., Martell, Calif., for collecting the tree sections used in this investigation.

High-Temperature Pressure Piping

ERIC A. KERBEY

A summary is given of the various piping materials and recommendations are made for the selection at various operating temperatures. Attention is also called to the need for proper installation to allow for expansion.

In any review of papermaking history one is impressed by the dramatic changes that have transformed the industry in relatively recent times. A brief century and a half ago, the manufacture of paper was a laborious hand process—tedious, expensive, and highly inefficient. Today, modern papermaking is a vastly intricate, highly mechanized industrial complex of tremendous capacity, and its efficiency is evident in the remarkably low cost of its products.

Paralleling the growth of the pulp and paper industry is the development of steam generation, a process which long ago displaced water power as the basic source of energy in paper mills, and which today is the vital power source not only in that field, but in almost every element of industry. As the requirements of industrial and public utility plants became more rigorous, the demand for greater efficiency and economy in steam generation increased by leaps and bounds; particularly in central power stations, the economics of the steam heat cycle has forced temperatures and pressures to ever higher levels. Obviously, this presents a series of new problems to the manufacturers and designers of boilers, equipment, and piping.

Until several years ago, the highest temperatures encountered in paper mill steam piping were 700 to 750°F., close to but not impinging upon the upper limits for carbon steel material. Today, we are informed that at least three mills are designing for operation at 900°F. and 1200 p.s.i.—an entirely different condition involving a host of new and perhaps unfamiliar considerations.

The effect of such increasingly severe operating conditions on steam piping systems is the subject of this discussion. In approaching it, let us keep in mind three points of view: that of the designing engineer, that of the piping fabricator, and that of the piping erector or contractor.

CODES AND SPECIFICATIONS

As rising pressures and temperatures move into unfamiliar territory, as power generating equipment becomes more involved, we find that the various codes and specifications controlling piping are correspondingly multiplied and compounded—codes which must be considered in design and manufacture. Under current conditions it is unfortunately but necessarily true that piping systems for exacting service cannot be designed and cannot be manufactured and erected without highly detailed and exhaustive knowledge of many lengthy regulations.

Eric A. Kerbey, Executive Vice-President, Midwest Piping & Supply Co., Inc., St. Louis, Mo.

In the scope of this discussion, we cannot attempt more than a perfunctory outline of this problem. But it must be mentioned if only to draw attention to the following two points:

The Complexity of Codes

Fabricated piping for steam power installations must comply with the ASA Code for Pressure Piping (B31.1); with applicable parts of the ASME Power Boiler Code; with the AWS regulations governing welding; and in some cases, with elaborate state codes. Each of these regulations is, in turn, crammed with reference to other specifications: for pipe and tubing, for valves, for fittings; for heat treatment and hydrostatic testing; and design details such as nozzle reinforcement. And at high temperatures many new materials specifications must be considered, each of which adds a fresh ingredient to this mixed salad of code requirements.

Their Constantly Changing Nature

Secondly, code requirements are almost never static. The code for pressure piping, for example, was completely revised and re-issued just a few months ago, but already the stress values for $1^1/_4\%$ chrome–$^1/_2\%$ moly alloy steel pipe have been drastically changed by issuance of Case No. 5, an interim directive. Similarly, ASTM Specification A-158, covering alloy pipe for high-temperature service, was issued in 1937, was revised *ten times* in a 12-year period—and is now undergoing another complete overhaul in committee sessions! Small wonder, then, that designers and suppliers—and operators—of steam piping are forced to build up a body of competent engineers whose chief occupation is the interpretation and application of piping codes and specifications.

PIPING MATERIALS

One of the first considerations in the design of piping is the selection of the proper grade of steel. In this, three factors must be held in mind: the performance of the steel under the expected operating conditions; its workability in bending, lapping, forming, and welding; and its availability.

Performance

From the standpoint of the metal's serviceability, the designing engineer usually classifies the various steels used in piping into four groups, as charted in Table I:

1. Carbon steel, for temperatures up to 775°F.
2. Low-alloy steel, for temperatures of 775–975°F.
3. Medium-alloy steel, for temperatures of 975–1100°F.
4. High-alloy steel, for temperatures above 1100°F.

Low-carbon steels are generally furnished to one of two ASTM specifications: A-53, or A-106. These are

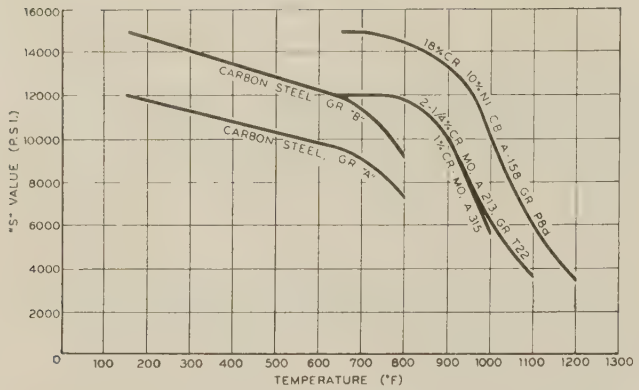

Fig. 1. Maximum allowable stress ("S") values

alike in their physical strength requirements: they differ in that A-106 stipulates more exacting chemical limits and more rigorous testing of the steel. As a result, A-106 is commonly preferred for the type of service being discussed. Both, however, are well suited to forming and welding operations.

Carbon steels to A-53 or A-106 are available in either grade A or grade B, the distinction lying primarily in the higher physical properties of grade B steel. This permits the use of grade B at somewhat higher pressures than those permitted for grade A.

Steels to these specifications have been and will continue to be used extensively in high-temperature piping. However, when operating temperatures rise above 750°F. carbon steel loses strength rapidly, especially in resistance to creep, and it is therefore not recommended when service temperatures during continuous operation exceed 775°F.

Low-alloy steels in general piping service, as shown in Table I, include one grade of carbon-moly, and five grades of chrome-moly in which the amount of chromium varies from $^1/_2$ to 2%. All of these contain approximately $^1/_2$% of molybdenum except for the $1^3/_4$% chrome alloy, in which the moly content ranges from 0.60 to 0.80%.

Until recently, carbon-moly pipe to A-206 was largely used for service at 800 or 900°F. due to its excellent creep resistance. But in 1943, the failure of a section of carbon-moly pipe in utility service brought to light a phenomenon now known as "graphitization." The ruptured piping revealed a series of pure graphite flakes along the grain boundaries in the heat-affected zone of the weld, a defect which, of course, brought about a critical reduction in the physical properties of the pipe.

Early studies of this type of failure indicated that graphitization could be controlled by decreasing the amount of aluminum used to kill the steel, and occasioned a general re-writing of pipe specifications to limit this practice. However, further research proved that an even surer cure for graphitization lay in the addition of small amounts of chromium ($^1/_2$ to 1%) to the melt, and the result was a sharp switch to the use of low chrome-moly steels in high-temperature service.

The $^1/_2$, 1, $1^1/_4$% chrome-molys of this group are extensively used in power plants and other installations where service is exacting. They are generally recommended where the continuous operating temperature does not exceed 975°F. for at or below this level, the chromium content effectively inhibits graphitization. The same, of course, is true of the 2% chrome-moly steel which has the added advantage of economical resistance to moderate corrosion.

Medium-alloy steels in piping service may be considered as those containing chromium in amounts from $2^1/_4$ to 10%, with molybdenum ranging from $^1/_2$ to 1%. The most commonly used grades are listed in Table I.

Of this group, the steel most commonly used in steam piping is the $2^1/_4$% chrome-moly grade. It has exceptional creep strength, excellent resistance to graphitization, and has been successfully used in power installations at 1050 to 1100°F.

The balance of the steels in this group, at present, find their widest use in the oil refining, rather than the steam generating, field. The 5% chrome-moly (generally called "4–6 Chrome") is especially popular because of its excellent corrosion resistance, high creep strength, and superior resistance to oxidation. The $2^1/_4$% chrome-moly is also used in polymerization and cracking units, and the 7 and 9% alloys for such severe operating service as that found in hydrogenation processes where high corrosion and oxidation resistance is a prime necessity.

High-alloy steels in critical piping service include a variety of stainless types, both ferritic and austenitic. These are metals with chromium content in excess of 10%, such as the six grades shown.

The first group of three, the high-chrome ferritic steels, are used in heat exchangers, catalytic cracking units, and dehydrogenation equipment in the chemical and oil refining industries. The 27% chrome steel is also used for stationary soot-blower elements in steam boilers.

The chrome-nickel austenitic steels in the second group (often called 18–8 steels, from their chrome and nickel content) are used quite widely in applications calling for the ability to resist corrosion, and their unusual creep-and-rupture-resistant properties are making them a factor in steam piping at elevated temperatures and pressures. However, as shall be indicated, they are subject to certain intergranular changes in the processes of forming and welding which often serve to limit their usefulness.

Indeed, it might be wise at this point to add a word of general caution regarding the use of 18–8 chrome-

Fig. 2

Table I. Piping Materials

Group	Operating temperature, °F.	Basic analysis	AISI or ASTM spec.
Carbon steel	Under 775	Carbon steel	A-53, gr. A A-106, gr. A A-53, gr. B A-106, gr. B
Low alloy	775–975	Carbon-moly	A-206
		½ Cr-Mo	A-280
		1 Cr-Mo	A-315
		1¼ Cr-Mo	A-158, gr. P11
		1¾ Cr-Mo	A-158, gr. P3a
		2Cr-Mo	A-158, gr. P3b
Medium alloy	975–1100	2¼ Cr-Mo	A-213, gr. T22
		3 Cr-Mo	A-213, gr. T21
		5 Cr-Mo	A-158, gr. P5a
		7 Cr-Mo	A-158, gr. P16
		9 Cr-Mo	A-158, gr. P17
High alloy	Over 1100	13 Cr	Type 403
		17 Cr	Type 430
		27 Cr	Type 446
		18 Cr-8Ni	Type 304; A-158, gr. P8d
		17 Cr-12Ni-Mo	Type 316; A-213, gr. TP316
		18 Cr-10Ni-Cb	Type 347; A-158, gr. P8d

nickel steels. Although the use of these metals is very common, there are still many unknown factors in their natures. This is particularly true in the welding of heavy sections, in operation under stress-corrosion conditions, and in the correlation between service life and laboratory corrosion tests. Too often there is a tendency to regard these steels as "cure-alls" for difficult operating conditions; in actual service, under certain conditions, the stainless steels have been known to operate less satisfactorily than low-alloy, or even carbon steel, material.

The foregoing discussion of high-temperature piping materials can perhaps be high-lighted graphically by reference to Fig. 1, which charts the allowable stress values for four representative steels, one from each group. To illustrate the difference between grade A and grade B carbon steel pipe, data for both are shown. The values plotted here were taken from the ASA Code for Pressure Piping and the ASME Power Boiler Code, and illustrate very clearly the abrupt drop in the design strength of these metals as they approach their upper temperature limits.

Workability

From the standpoint of economy in original equipment costs the workability of carbon and alloy steels is very much the concern of the piping designer. But the behavior of these metals in manufacturing operations is obviously of even greater interest to the fabricator and the field erector. Therefore, let us view workability from their point of view.

Hot-forming operations, such as bending, forging, "Van Stoning" or lapping, swaging, etc., are much the same for all of the grades of steel that have been discussed. This may sound surprising at first hearing, but the reason for it is easily recognized when one considers that for main steam lines the common pipe sizes are 10 or 12-inch with wall thicknesses of 1, 1½-inches, or greater. Regardless of its chemical composition pipe of such heavy structure must be heated to at least 1800°F. for successful hot-working. Of course, if the properties of the steel are impaired by the forming heat the final assemblies are subjected to corrective heat treatment.

Welding is today one of the most important single operations in the fabrication of high-temperature piping. Flanged joints have virtually disappeared, and main steam lines in central power stations are now welded directly to the superheater outlet at one end, and to the turbine throttle valve at the other end. Valves in the line are of welding-end type (in some cases, the bonnets are of welded construction, too), and intermediate flanged joints have been displaced by field butt welds. Thus, more and more attention must be focused on the art and the quality of welding.

In carbon steel lines, recent years have seen the adoption of the submerged-arc machine weld in the fabricating shop. As may be noted in Fig. 2, this device comprises a submerged-arc welding head suspended from a gantry so that the welding apparatus may be moved into position over fabricated sections in different parts of the welding bay. The piping to be joined is clamped in a turning device, which rotates the piping under the welding head as the beads are being laid. The welding here is virtually automatic: amperage, voltage, length of arc, and speed of travel are all machine-controlled.

The submerged-arc welding machine, at present, is limited to butt welds, attachment welds for slip-on flanges, and other relatively simple types. Furthermore, the proper electrodes for submerged-arc welding of alloy steels are not yet readily available so that, currently, alloy welding is still done manually.

As in low and medium-temperature work the welding of high-temperature piping requires the very careful establishment of proper welding procedures in which are detailed the welding sequence, type and size of electrodes, voltage, amperage, preheating and postheating requirements, etc. Individual procedures must be established for butt welds made with and without backing rings. These procedures must then be qualified and exhaustively tested before they can be used with confidence on the alloy steels under discussion.

An even more exacting task, however, is the organization of a group of competent welders. Difficult enough in the shop, even more exasperating in the field, the selection and testing of welders for alloy work is still further complicated by the fact that it is often necessary to start from scratch and train and develop

Table II. Heat Treatment of Piping Materials

Material	Spec.	Operating temperature[a]	Heat treatment[a]		
			Preheat	Postheat	Anneal
Carbon steel	A-106-A	Under 775	None[b]	None[b]	None
1% Cr-Mo	A-315	775–975	400–600	1300–1350	None
2¼% Cr-Mo	A-213-T22	975–1100	400–600	1300–1350	1550
18% Cr-8% Ni	A-158-P8a	Over 1100	None	None	2000

[a] In °F.
[b] In thicknesses less than 1 inch. Heavier sections require preheat at 300–600°F. and postheat at 1150–1250°F.

welders in the use of unfamiliar procedures and materials and electrodes.

Heat treatment of course, is more elaborate for the alloy steels than for the carbon steels. As may be noted from Table II, the latter require no special precautions or heat treatment, save in thicknesses above 1 inch. Heavier sections are commonly given a welding preheat at 300 to 600°F., and should be stress relieved at 1150 to 1250°F.

Low-alloy steels are almost as easily handled as carbon steels, however, it is advisable to preheat and to stress-relieve these metals, regardless of wall thickness, when welded construction or hot-forming are entailed. Four to six hundred degrees Fahrenheit is the proper range for the preheat, and 1300 to 1350°F. for the post-heat.

Medium-alloy steels bring with them the problem of air-hardening and brittleness following hot-forming or welding. Consequently, heat treatment at about 1350°F. should follow hot-forming. Welding requires preheating at 400 to 600°F., and an immediate post-welding stress relief at 1300 to 1350°F. In addition, a full anneal at 1550°F. should be employed if at all possible.

In Fig. 3 is shown the type of furnace used for annealing certain of the medium-alloy steels. Fabricated piping is charged into this furnace in carload lots, to undergo a heating cycle which may occupy as long a time as 26 hours with temperature changes at some stages held to a maximum of 50° per hour.

Note that the heat treatment suggested for low- and medium-alloy steels is not inflexible. For example, we would not be concerned about final results if we were to weld thin-walled (i.e., Schedule 40) carbon-moly pipe without preheat; nor if we could not immediately postheat $2^1/_4\%$ chrome-moly. And in field welding, the $2^1/_4\%$ chrome-moly is often stress-relieved at 1350°F. without a later anneal at 1550°F. In the shop this steel is annealed or normalized and tempered because facilities are readily available, and because we find that optimum strength and creep properties are thus developed. But in the field, the equipment for full-furnace annealing is seldom at hand, and the 1350°F. stress-relief is sufficient to soften the weld deposit satisfactorily.

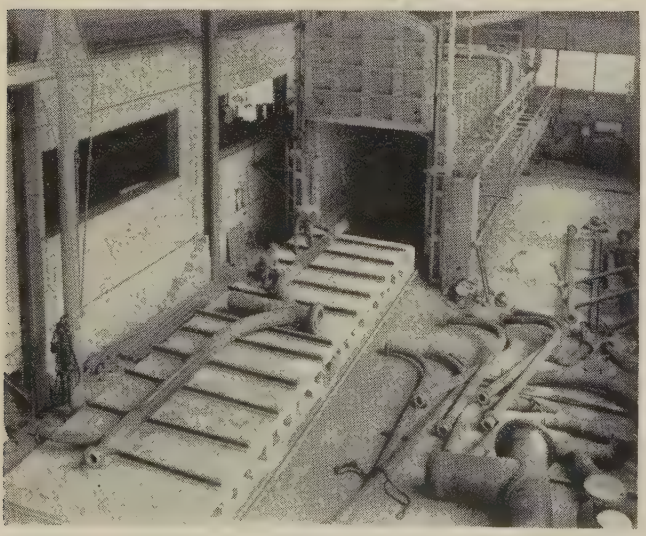

Fig. 3

Fig. 4

High-alloy steels are even more difficult to work than medium-alloy material. This is particularly true of the straight-chrome steels which become very brittle when service temperatures fall in a certain range. In addition, they are notch-sensitive and difficult to weld.

Chrome-nickel steels, too, have characteristics which complicate their heat treatment. The 18–8 alloys, when heated to certain temperatures, are subject to a reduction of corrosion resistance and physical properties caused by the precipitation of chromium carbides at the grain boundaries. Hot working of stainless steels must be accomplished at temperatures of 1900 to 2000°F.—a degree of heat which, like that incurred in welding, commonly causes carbide precipitation. The restoration of full corrosion resistance and physical properties in the basic 18–8 steels therefore requires a full anneal at 2000°F. followed by quenching or quick-cooling in water, oil, or air.

To minimize carbide precipitation small amounts of columbium or titanium are sometimes added to the melt to "stabilize" the metal: i.e., to cause the precipitation of harmless columbium carbides or titanium carbides in place of the chromium carbides. These stabilized stainless steels, such as the columbium-bearing type 347, are widely used in piping to simplify heat treatment of field welds; when strength and creep resistance, rather than corrosion resistance, are the essential requirements, stabilized chrome-nickel steels may be welded with only local postheat treatment.

Testing is another province in which alloy steel piping is more demanding than carbon steel. Bends are sometimes checked by supersonic methods to insure full wall thickness and freedom from internal defects. The effects of heat treatment are often assayed by cutting test coupons, which are then etched and examined microscopically to make sure that the proper microstructure and grain size have been re-established. Welds may be tested for soundness by Magnaflux or Zyglo methods, by x-ray, or by radiographic examination with radium or cobalt 60.

Two of these methods are illustrated in Figs. 4 and 5. The first of these shows an operator examining 14-inch O. D. by $1^1/_2$-inch type 347 stainless steel 90° ells by the Zyglo method in which the piping is coated with a penetrating oil, wiped clean, and examined by "black light" for

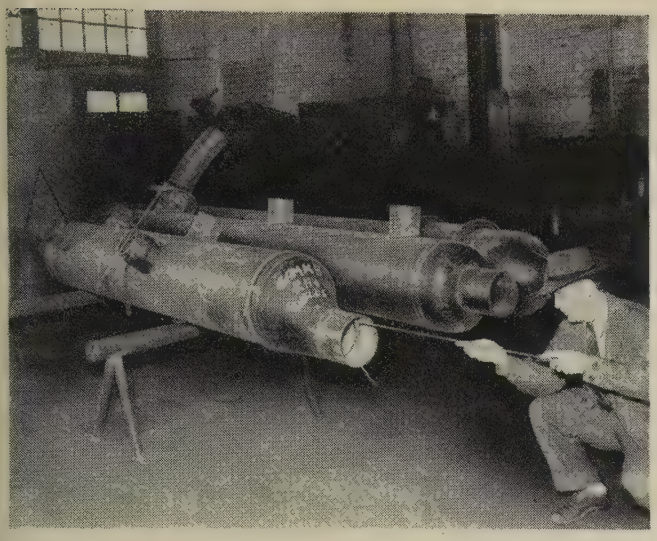

Fig. 5

cracks and other surface defects. Figure 5 shows gamma-ray examination of piping. Film cassettes are strapped to the outside of the weld, and the radium capsule being inserted by the operator will leave a radiograph of the weld, showing any slag inclusions, pinholes, or other faults.

It will be readily appreciated that all of these methods of testing have one thing in common—they require special equipment and skilled personnel if they are to be of any value whatsoever.

Internal cleaning, like quality control, is much more elaborate in high-temperature piping work than in ordinary fabrication. Weld spatter must be kept to a minimum and in some cases entirely removed; icicles, of course, are strictly taboo. Loose scale must be removed, and, frequently, the elimination of all internal scale and grease is demanded. Accordingly, high-temperature piping will usually require such operations as turbinizing or pickling, either alone or in combination. The turbinizing operation is pictured in Fig. 6; note that the equipment consists of a set of rotary cutters which are driven through the pipe by compressed air to remove scale, weld spatter, etc.

The need for these elaborate precautions is readily apparent when one visualizes the damage that can be done to modern power generating equipment by even small particles of scale.

Availability

What can one say today about the availability of carbon and alloy steels? Little that is printable. A year or so ago, fairly useful information on this score could be offered but current government regulations and the increasing difficulty of obtaining *any* steel materials make it hard to do so today. This much might perhaps be said: 1% chrome-moly is generally more easily obtained than $^1/_2$% chrome-moly; and $2^1/_4$% is less difficult to come by than 3%. However, at present all alloy steel mill melt schedules are subject to item-by-item approval in Washington, and alloy rollings will not be permitted to remain on those schedules unless (1) it can be proved that no substitute material, such as carbon steel, will do the job, and (2) the end-use for the metal can be tied in with the direct-defense or the defense-supporting programs. Before proceeding with plans for alloy piping, we therefore suggest a conference with the Iron and Steel Division of the NPA, or with officials in your own industry division.

EXPANSION AND FLEXIBILITY

Increased temperatures operate in two ways to present the piping designer with more difficult problems of expansion and flexibility. In the first place, greater temperatures obviously mean greater expansion, hence in a high-temperature steam line which may expand as much as 9 inches per hundred feet, flexibility becomes a very serious consideration. On the other hand, allowable working stresses must be reduced as temperatures rise (see Fig. 1); this requires greater pipe wall thicknesses which in turn tend to reduce the flexibility of the system. The net result of these two effects is to compound the problem of flexibility so that the designer must give increasing attention to the means of accommodating pipe expansion—not only to prevent distortion and rupture of the piping itself, but also to prevent the steam line from exerting excessive reaction on the equipment it connects. In many cases, the manufacturers of turbines and other equipment now specify maximum permissible thrust at connections, and some ask that piping layouts be submitted for flexibility analysis by their own engineers.

In high-temperature, high-pressure steam lines the simple and relatively inexpensive expansion joint is no longer adequate, and the designer must therefore plan on absorption of thermal expansion by the bending or movement of the pipe alone. A familiar form of expansion-absorbing device in piping is the "hair-pin" or U bend, which have been commonly used in long runs of steam piping between boilers in one building and equipment in another. But inside the power plant structure the factor of space usually thwarts such a simple solution as this, and the engineer must resort to a more complicated piping configuration to compensate for expansion.

When the system is not too complex the first step in such a flexibility analysis may be the simplification of the problem to the greatest possible extent. Thus, the designer may elect to ignore the forces applied to a large steam line by the smaller, more flexible drip lines which enter it. Or he may, for analysis purposes, discount

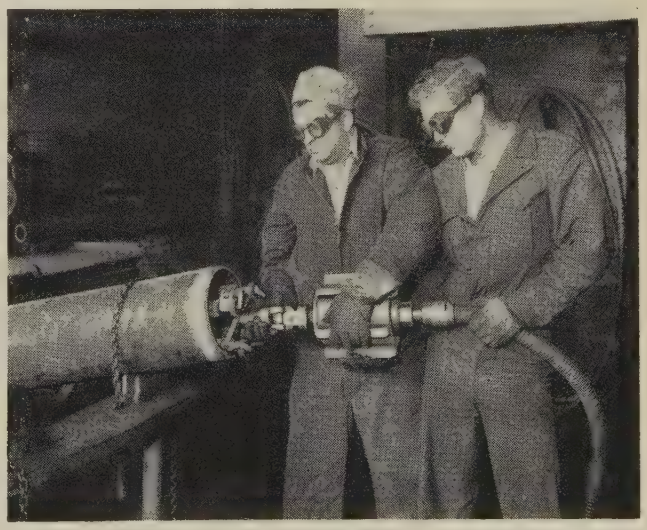

Fig. 6

certain minor directional changes which enable the piping to avoid building supports, equipment, walkways, etc. In so doing, of course, he must make sure that his final solution will provide enough "velvet" to keep his results on the side of safety.

By these steps, the engineer may be able to simplify his expansion problem to such a degree that it becomes one of the relatively few special cases which can be analyzed by means of simple graphs and tables available in various publications. Or, the simplified concept may lend itself to division into two or more parts for each of which such a "ready-made" solution is at hand, however, the highest type of engineering judgment is required to combine these separate solutions into one that is valid for the entire system.

But more often than not, the designer will find that even a drastically simplified idealization of his layout will be considerably more complex than those treated in standardized solutions. Then he must plunge into a bona fide analysis using one of a number of published methods, each having its own range of accuracy and its own group of followers. Among the best known of such schemes of flexibility analysis are these three:

1. The "grapho-analytical" method of Todd, Crocker and McCutchan.
2. The "analytical" method of the M. W. Kellogg Co.
3. The "elastic center" method of Spielvogel.

These are all good methods; they are basically the same as must be the case for any valid and complete analysis. Their similarity, however, extends to a common major disadvantage—they are not "automatic" and, hence, a considerable amount of time and study is required for the designer to learn to use them.

Our company is presently preparing a bulletin on flexibility computations which will further develop what we believe to be one of the most practical and useful methods of analysis: the "tabular-integration" method developed by R. C. Powell and the late W. G. Hooper, Vice-President of Midwest Piping and Supply Co. A brief outline of this system, in the form of a sample solution, was published in *Heating, Piping and Air Conditioning* for Nov., 1946 (pages 70–76). While the details of this method will not become generally available for several months, it is not out of place here to remark briefly on this procedure and its advantages.

Its essence is a set of tabular forms. In spaces provided at the top of the first form the engineer enters the basic data of the flexibility problem. Once this has been recorded the solution is "automatic" in that the arrangement of the form leads directly from one step to the next; the engineer has only to fill out the appropriate blanks as he proceeds through the chain of calculations plotted on the form. At no time need he be concerned with what he should do next, or whether he has forgotten this variable or that factor. Indeed, a clerk familiar with slide rule operation can complete the analysis without difficulty.

The "tabular integration" method is at present in use in our own engineering department, and has been circulated to a limited extent among other piping engineers. With the completion of the bulletin now in work, it will be ready for general distribution, and we will then be very happy to furnish copies to those who are interested in a more thorough examination of the problems of expansion and flexibility.

HANGERS, ANCHORS, AND SUPPORTS

Before the advent of the elevated temperatures and pressures now encountered in steam generation, hangers and anchors were considered as "salt and pepper on the table." Thermal expansion at low temperatures was small, and often a barrel of semirigid hangers and a keg of springs sufficed to support the piping installation. Too often no attempt at serious design was made, and the supporting of the system was left to the discretion of the job superintendent.

As operating temperatures rose higher and higher it became increasingly more important that the piping designer himself should plan the supporting system. By having the design of piping and of hangers under one responsibility the horizontal runs can be located with ample clearance of the floor beams to allow for spring cages, the vertical runs will be anchored so that movement is not excessive, and the pipe runs will be placed for the most efficient and economical support.

There is an additional reason for coordinating the design of piping and supports in the fact that it is common practice to ignore the effects of hangers and of the dead weight of piping in making flexibility calculations. Accordingly, the actual design of piping supports must avoid invalidating the assumptions underlying the flexibility analysis.

While the usual compensations made for thermal expansion assume, in effect, that constant support hangers will be used throughout, except for critical cases there may be enough "velvet" in the flexibility analysis to permit using the simpler caged spring hangers, or even in many cases the inflexible rod and clamp type. We can give no general rules which will apply to all cases, except to say that constant support hangers are most frequently called for in the large, stiff, hot systems such as main steam and reheat steam. On the other hand, it is not uncommon that drip piping, which is so small in diameter and thus so inherently flexible, may be satisfactorily supported by rigid hangers even though temperatures become quite high. Beyond this generalization we cannot go in this discussion; more detailed rules will depend upon the individual problem, and usually the design of hangers, anchors, and supports will call for the same degree of engineering judgment and skill as is required for the design of the piping itself.

CONCLUSION

It is regretted that space does not permit a more elaborate discussion of the problems involved in high-temperature piping systems. We have touched briefly on codes and on supports; in accordance with your suggestions, we have treated in greater detail the subjects of materials and flexibility. But this limited analysis is intended to do no more than to outline some of the problems involved in high-temperature pressure piping systems, and to emphasize a thread of thought which inevitably must be woven through any discussion of this topic: that at temperatures above 750°F., every aspect of the piping problem—design, fabrication, and erection—becomes more exacting in its demand for special knowledge, special skill, and special equipment.

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The Ignition Temperature of Certain Pulps and Other Wood Components

M. A. BUCHANAN

Sulphite and kraft pulps have an ignition temperature of about 260°C. as determined by a method utilizing a relatively short heating time. The ignition temperature of groundwood and semichemical pulps and wood is in the range of 210 to 230°C. The difference is due to lignin and hemicelluloses, both of which appear to have an ignition temperature of about 180°C.

IGNITION temperature is an important property of combustible substances such as cellulosic materials. At temperatures below this point the material may suffer loss in weight but even extensive decomposition does not lead to active combustion. On the other hand, if the material is heated to the ignition temperature or above, the exothermic reaction increases the temperature further so that active combustion does occur, provided sufficient oxygen is available and provided external cooling is insufficient to counteract the exothermic reaction.

Unfortunately, ignition temperature is difficult to define and many investigators have assigned somewhat different meanings to the term (*1*). In addition many different procedures have been used to determine the ignition temperature. One of the better definitions is given in a brief report of work done at the Bureau of Standards (*2*) as follows: "One of the fire hazard properties of a material is defined as the lowest initial temperature from which, under favoring conditions, it will heat spontaneously until glow or flame occurs." This definition does not specifically designate the time element, but the data given in this report clearly indicate the importance of this factor. For example, cellulose (filter paper) had an ignition temperature of 232°C. when heated at this temperature for 7 to 9 hours, but when heated for only $^1/_2$ hour a temperature of 280°C. was required to produce noticeable self heating. Samples of the cellulose heated for 45 hours at 230°C. or 70 hours at 228°C. did not exhibit self heating although there was a weight loss of 60 to 75%.

Edwards and Harrison (*1*) determined the ignition temperature of several cellulosic materials by a method which involves a very short heating time. This is probably one of the reasons that they obtained a value of 354°C. for the ignition temperature of cellulose. Some of the other values reported by Edwards and Harrison were: wood pulp dust 272, wood flour 277, paper dust 337, and corn starch 324°C.

Brown (*3*) reported the following ignition temperature values: filter paper 254, cellophane 242, cellulose papers 239, cellulose acetate 314, newsprint 184, western red cedar 192, white pine 208, long leaf pine 220, white oak 210, paper birch 204, jute fiber 193, and absorbent cotton 228°C. These values were determined by a method similar to that used in the present study.

The ignition temperature of several species of Japanese woods has been reported to be in the range of 404 to 468°C. (*4*). The method used for the determination was not abstracted, however, and it seems likely that these values may represent the temperature at which active combustion occurs rather than the temperature at which the exothermic reaction is initiated.

DETERMINATION OF THE IGNITION TEMPERATURE

Ignition temperatures were determined by a method developed by VanKleeck (*5*). This method was selected because it is reasonably rapid and because it gives results which are representative of the effect of short heating periods. A photograph of the apparatus is shown in Fig. 1 and a cross section of the furnace assembly in Fig. 2. The sample was placed in a 25 by 70-mm. alundum extraction thimble which had $18^1/_{16}$-inch holes drilled in the bottom. This thimble was supported by a 56-mm. length of alundum tubing cut from the top of an extraction thimble. The two alundum pieces were inserted in an asbestos tube made from asbestos paper and sodium silicate. This tube had a wall thickness of 10 mm. and was 135 mm. long. A 12-turn coil of $^1/_4$-inch copper tubing surrounded the asbestos tube and served to heat the air admitted to the bottom of the alundum tube. Two chromel-alumel thermocouples were used, one within the sample and the other in the air stream below the sample.

A 2-gram sample was placed around the thermocouple in the alundum thimble and air was passed through the copper coil at a rate of 1.8 liters per minute. The furnace was then turned on, using a rheostat setting which resulted in a temperature rise of 4.5 to 7°C. per minute in the temperature range of 200 to 270°C. An electric timer was started when the furnace was turned on. In the first part of the heating cycle, time-temperature readings were taken for both thermocouples. After reaching a temperature approximately 50° below the ignition temperature, readings were taken only for the thermocouple within the sample. These readings were taken about every 2.5° and required the full attention of the operator. Shortly after the ignition temperature was reached, the rate of temperature rise was very rapid and the temperature interval between readings was necessarily greater. After the maximum temperature had been reached, the rate of temperature change was less and it was possible to

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obtain some readings for both thermocouples. The temperature data were plotted as a function of time. The point at which the slope of the curve for the upper thermocouple data began to increase was taken as the ignition temperature. The increase was small at first and it was necessary to plot the data on a large scale.

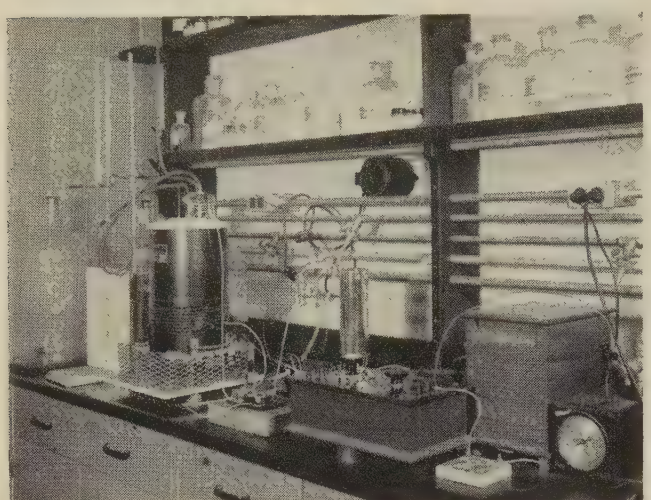

Fig. 1. Apparatus for determination of ignition temperatures

Data for a typical test are plotted in Figs. 3 and 4. This test, which was made on bleached sulphite pulp, indicated an ignition temperature of 264 °C. Figure 3 illustrates the small change in the slope of the curve at the ignition temperature. Figure 4 shows the temperature of the air below the sample and also shows the large rise in temperature which occurs shortly after the ignition temperature is reached.

This method, which was developed for small chips of wood, was also satisfactory for most of the powdered lignins tested. In most instances the pulps were disintegrated in an Abbé mill before testing but, in some instances, the pulps were cut into small strips. These strips gave the same results as those obtained from the Abbé milled samples. Small changes in the rate of heating and the rate of air flow did not affect the results. There was an uncertainty of about 2.5° in determining the end point, but duplicate determinations in general checked within 5°. The results therefore are reported to the nearest 5°.

RESULTS AND DISCUSSION

This work was initiated to determine the ignition temperature of isolated lignins because these data were not available. Meadol is a commercial lignin prepared from the black liquor resulting from the soda pulping of hardwoods. Indulin A is likewise a commercial lignin and is obtained from the black liquor from the kraft pulping of softwoods. Both these lignins are dissolved from wood by alkaline cooking liquors. Scholler lignin is isolated from wood by hydrolyzing the wood with dilute sulphuric acid at a high temperature. Willstätter lignin is isolated by hydrolyzing wood with cold 42% hydrochloric acid. As shown in Table I, these four lignin preparations have about the same ignition temperature and all have an ignition temperature appreciably lower than the values usually reported for wood. These lignins have been modified by the isolation procedures and undoubtedly differ from the protolignin as it exists in wood. However, the fact that the four samples have essentially the same ignition temperature suggests that lignin in wood has a relatively low ignition temperature. An attempt was made to test a sample of native lignin isolated from sprucewood by Brauns' procedure (*6*) but, in this case, a definite end point was not obtained.

Table I. Ignition Temperature of Isolated Lignins

Lignin	*Ignition temperature, °C. (±5°C.)*
Meadol	185
Scholler lignin	180
Indulin A	185
Willstätter spruce lignin	180
Calcium lignosulphonate	235

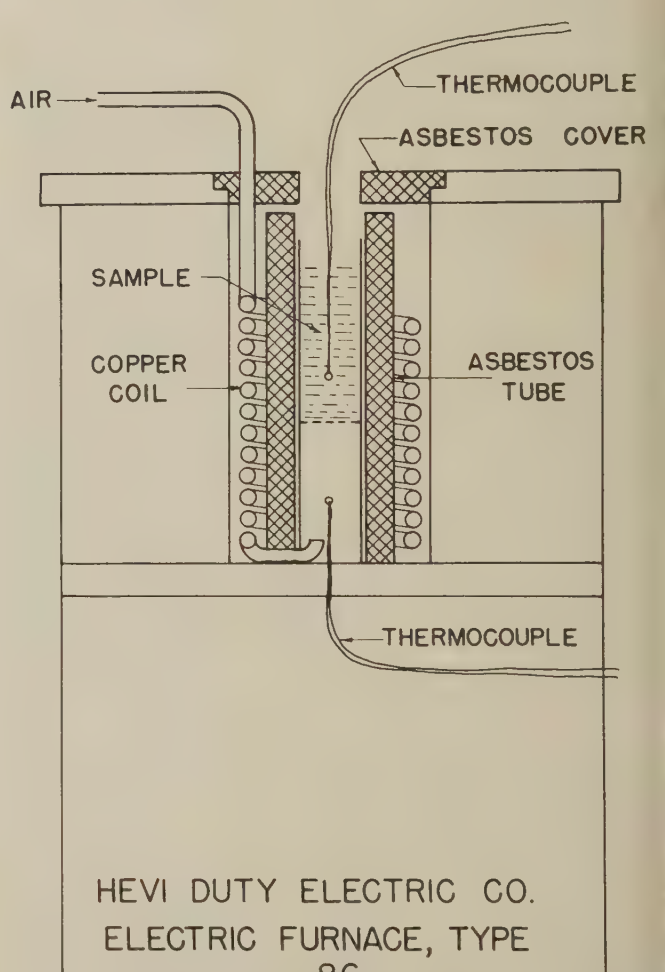

Fig. 2. Cross section of furnace assembly

Evidently, this sample of lignin fused before the ignition temperature was reached and this prevented free access of air to the interior of the sample.

In contrast to the above lignins, calcium lignosulphonate has an ignition point as high or slightly higher than that of wood. This suggests that the sul-

phonate group and/or the metallic salt causes an appreciable increase in the ignition temperature.

A series of samples prepared from the same lot of slash pine wood was available (*7*). The data in Table II illustrate the effect of delignification on the

Table II. Ignition Temperature of Certain Wood Components

(All Samples Were Extractive Free)

Sample	*Lignin, %*	*Ignition temperature, °C. (±5°C.)*
Slash pine wood meal	27.5	230
Slash pine semichemical pulp	27.2	215
Chlorited slash pine semichemical pulp	4.2	250
Slash pine kraft pulp	3.4	260
Slash pine alpha-cellulose	...	260
Aspen hemicellulose	...	180
Spruce hemicellulose	...	170

ignition temperature. A kraft semichemical pulp prepared in a yield of 74% had a lignin content almost equal to that of the original wood and actually had a slightly lower ignition temperature than did the wood. Removal of most of the lignin with acidified sodium chlorite produced an appreciable increase in the ignition temperature. Both the alpha-cellulose prepared from the semichemical pulp and a normal kraft pulp had slightly higher ignition temperatures than did the delignified semichemical pulp. This small difference is probably due to the presence of hemicellulose material in the chlorited semichemical pulp, because two samples of hemicellulose isolated from aspen wood had an ignition temperature of only 180°C., and one sample of hemicellulose isolated from black spruce holocellulose by extraction with 5% potassium hydroxide (*8*) had an ignition temperature of 170°C. One sample of the aspen hemicellulose was isolated directly from aspen wood by extraction with 5% sodium hydroxide at room temperature and the other sample was isolated by 5% potassium hydroxide extraction of an aspen holocellulose prepared by a modified Thomas procedure (*9*).

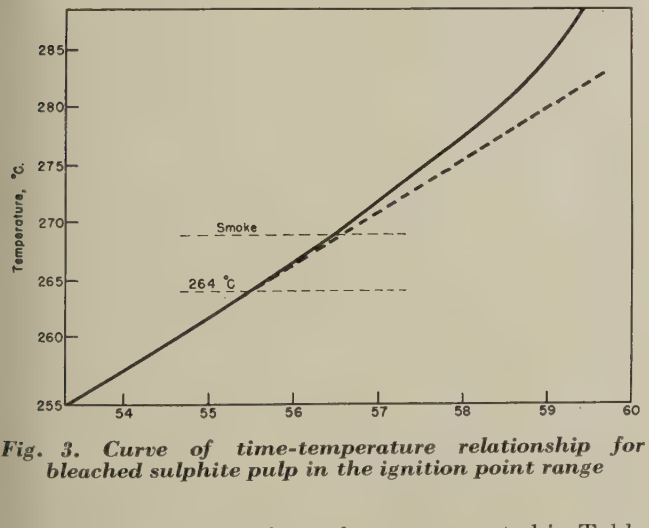

Fig. 3. Curve of time-temperature relationship for bleached sulphite pulp in the ignition point range

Data for representative pulps are presented in Table III. A sample of cotton linters had the highest ignition temperature of any material tested. This sample is essentially free of lignin and hemicelluloses. Sulphite and kraft pulps were approximately equivalent as regards ignition temperature and, in the case of these pulps, bleaching does not have an appreciable effect on the ignition temperature. Mechanical pulp has a low ignition temperature and, like the semichemical pulps, is somewhat lower than wood itself. The

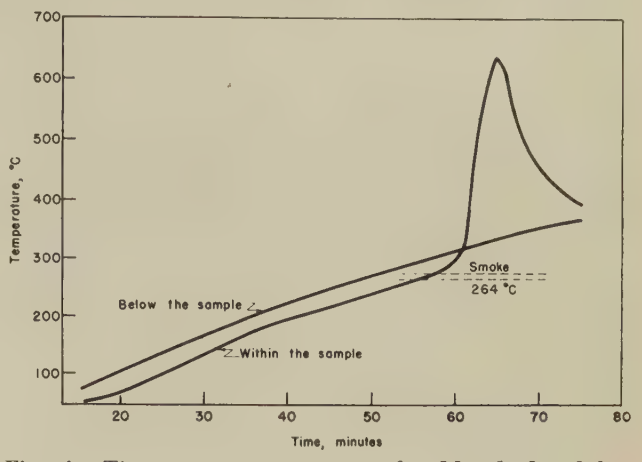

Fig. 4. Time-temperature curve for bleached sulphite pulp

aspen semichemical pulp was prepared by cooking aspen wood with neutral sulphite; the yield was 79%. The one sample of hemp pulp tested is intermediate as regards ignition temperature.

Table III. Ignition Temperature of Pulps

Pulp	*Ignition temperature, °C. (±5°C.)*
Spruce groundwood	210
Aspen semichemical pulp	215
Bleached sulphite	265
Unbleached sulphite	260
Unbleached kraft	260
Bleached kraft	260
Cotton linters	275
Unbleached manila hemp	240

As discussed previously, time is an important factor in the determination of the ignition temperature. The data reported here were obtained by a method which utilizes a relatively short heating time and, therefore, the results are probably appreciably higher than would be obtained by a longer heating time, such as that used by the Bureau of Standards (*2*). The present results, however, are of value in describing the effect of short heating of the samples and illustrate the deleterious effect of lignin and hemicellulose on the ignition temperature.

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Modern Developments in Barking Drum Design

GEORGE M. DICK

The removal of bark from pulpwood by means of drum barkers continues to be the most economical of all barking processes for normal size logs, and barking drum design, therefore, continues to be of considerable interest to the majority of pulp and paper manufacturers. The wide variety of ideas underlying this design is an interesting study and the effect on this design of modern welding technique is important. Comparison of contemporary construction with details of a modern all-welded barking drum based on a wide analysis of the underlying fundamentals shows how maintenance costs which are a vital factor in barking expense are likely to be greatly reduced with the introduction of this latest form of barking drum construction.

THE removal of bark from pulpwood by means of drum barkers continues to be the most popular of all barking procedures for normal sized logs embracing the greatest volume and lowest cost method. Many attempts have been made to substitute alternative barking systems, but so far, most of these alternatives while possibly incorporating various advantages over drum barking have fallen far short in the over-all economies involved.

The greatest difference between drum barkers and their contemporary barking systems seems to be in the basic idea which uses mass barking procedures as the fundamental principle utilizing the falling and rolling action of the logs to contribute the major portion of the work while the feeding and discharging operations are held to a minimum in power requirements, supervision, etc. Thus huge quantities of logs can be handled through the barking process with only a minimum amount of power consumption and supervisory expense.

The alternative barking schemes are usually of the single track principle involving one log going through the barking device at a time, hence the controlling factor is the lineal speed possible. In order to get suitable volume through such devices, the lineal speed must be kept as high as can be arranged and this means exceptional refinements in feeding and supporting schemes with rather serious consequences in blockages if the feeding devices do not function exactly as required.

In the drum barker most of the work is done by one log tumbling against another, thus minimizing the external power required while with the single-track type of barker, mechanized bark removal mediums such as knives, chains, or similar devices must be employed. These devices being of a cutting or rubbing type require power to apply, therefore, the over-all power for such a unit is much higher per unit of wood barked than is the case with drum barkers.

The popularity of drum barkers, therefore, remains high and interest in barking drum designs continues to engage and intrigue the pulp and paper industry at large because of the many attempts which have been made by manufacturers to provide a drum design which will withstand the severe shock loads which the drum barking process involves and, at the same time, require a minimum of maintenance. These designs cover a wide range of approach and a study of their development and recent improvements should prove interesting.

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HISTORICAL

For a considerable period of years barking drum shells were constructed principally by two alternative arrangements, the first by riveting together a series of longitudinal and circumferential members into a cage-type structure and the second by fabricating flat steel plates into cylindrical form with welded or riveted joints.

In the older designs of drums when the mills were satisfied with lower barking capacities than are expected today, the drum shells could be satisfactorily constructed from relatively thin steel shapes or sheets and by using rivets of suitable sizes for these steel thicknesses, satisfactory length of life was obtained using riveted joints.

Much of the other apparatus found around pulp and paper mills during this earlier period, such as digestors, was also of riveted construction and repairs to riveted joints could be quite readily taken care of by personnel and equipment maintained for this purpose. Decrease in the use of riveted structures in pulp and paper mills during recent years and the trend toward welded fabrication have caused a gradual limiting of the availability of both riveting crews and riveting equipment, thereby making the maintenance of riveted barking drums more difficult and less convenient.

Eventually, there developed a trend toward higher capacity production from barking drums which meant greater loadings and higher revolving speeds, all of which resulted in more severe barking drum duty. In an endeavor to meet this heavier service, it was necessary to gradually increase the thickness of the drum shell members in order to give suitable length of life to these parts and the use of these increased sections made the riveting requirements correspondingly difficult.

It was usually not possible to increase the diameter of the rivets to correspond and, therefore, the ratio of rivet diameter to plate thickness gradually became more unfavorable, making it more and more difficult to drive rivets tight and also to keep them tight during barking drum operation. Loose and broken rivets became an increasingly annoying problem and gradually forced consideration of the possibilities of welding as an alternative in barking drum construction.

The historical development of barking drum shell supporting systems also forms an interesting study,

embracing such alternatives as fixed rollers operating two per tire, compensating beams and rollers operating in sets of four per tire, chains and sprockets operating with the drum shells suspended, and more recently hydraulic supports.

Hydraulic supports for barking drums instead of rollers or chains have been used during recent years with the object of reducing maintenance on such parts, also of reducing the power consumed in driving the drum. These hydraulic supports consist essentially of water-filled chambers encircling the lower part of the barking drum tire in such a manner that the tire literally floats on a water support. Suitable seals are provided at the edges of the tires to allow the water to be kept under pressure.

Adjustable hydraulic shoes can also be used for this purpose, utilizing water under pressure to support the drum, while permitting adjustment to ensure uniformity of fitting to the tire surface.

It is claimed that power savings are effected by using hydraulic supports, but it must be kept in mind that the horsepower required for the pumps to produce the required water pressure must be added to the horsepower taken by the barking drum drive motor.

BARKING DRUM DESIGN DEVELOPMENT

In investigating the various factors which have influenced barking drum design in recent years, it is reasonably safe to say that the art of welding has probably played the major role. Most of the early barking drum shells used for fastenings either rivets or bolts, while today practically all barking drum shells manufactured use either welding completely for fastening the constituent parts or at least welding is employed for the major portion of the attachments.

The rapid advances in the technique of electric arc welding which have taken place in recent years have been important factors in the promotion of welding for this purpose, and the valuable contributions of the welding material and equipment suppliers to the improvement of welding processes have gradually changed the viewpoint of the pulp and paper industry to the point where welded construction in barking drums is looked on with considerably greater favor than it was a few years ago.

There was a time not so long ago when the application of welding to barking drum shells, even for repair purposes, was considered entirely wrong by some manufacturers and operators and such welding which was done usually resulted not only in failure of the welds, but also failure of the drum shell members adjacent to where the welds were located. These failures have been attributed to either incorrect welding technique or to the welds being located contrary to what has since been established as the basic rules of welded barking drum design.

Some barking drum designs particularly those using complete cylindrical shells have utilized welding either wholly or in part for fastenings for a number of years, but in most of these cases, the welding constituted a means of locking the various parts together rather than performing the main function of securing loaded members.

The study of contemporary barking drum shell construction which follows will, no doubt, be of interest. This study, of course, does not cover the entire field of barking drum construction, but can be considered representative of the general types used.

BARKING DRUM SHELL ANALYSIS

Cylindrical Shell Barking Drums

Typical of the class of barking drum using the cylindrical shell design is the drum manufactured by the Carthage Machine Co. of Carthage, N. Y. The drum consists of a cylindrical steel shell 12 feet diameter by 40 feet long, made in a single section from six longitudinal plates, approximately 1 inch in thickness welded together, with longitudinal welds, and having suitable bark slots cut at intervals between each of these longitudinal plates. Three-inch angle irons are welded inside the drum behind each of the bark slots in the direction of rotation. These angles perform the joint function of assisting in the rotating of the logs, and at the same time, in catching the bark and helping to get it out through the bark slots.

Reinforcing plates in the shape of horseshoe pieces are used to strengthen the main drum plates at the ends of the bark slots to minimize the tendency for cracks to start at these locations. Annular reinforcing rings are located on the exterior of the drum shell at suitable intervals in order to provide the necessary circular rigidity. This style of drum uses two tires only, and these tires are formed from steel plates rolled into circular shapes, and supported from the main shell by means of steel spacing rings. All the various parts described are held together by welding.

Another design of cylindrical shell construction is found in the drums manufactured by the Portland Co. of Portland Me. In this design, however, riveted connections are used between the plates of the cylindrical formation with butt straps providing the necessary continuity at the joints. Instead of the usual longitudinal bark slots, however, this manufacturer uses a system of circular bark slots located in groups between the tires and the gear and between the tire and the discharge head. These circular bark slots are arranged in a staggered pattern so as not to unduly weaken the drum plate construction, while a circular reinforcing plate is welded to the outside of the drum shell where the bark slots come through. This additional thickness of plate gives the extra strength necessary to reinforce the shell at this location. This circular bark slot idea has the advantage of concentrating the bark discharge at three places in the length of the drum shell, and by means of cross-conveyors, the bark can be readily accumulated and taken out to connect with the main bark conveyor running parallel to the drum. The over-all result is a tendency toward cleaner operation because of the greater concentration of bark discharge which this design permits.

An elaboration of this design manufactured by this same company is found in the construction where a multiplicity of drum sections is used to form a continous barking scheme with a drum shell approximately 10 feet diameter by 60 feet long. The five separate sections which constitute this drum are so arranged that each alternate section revolves in the opposite direction, and the bark removal procedure is accomplished mostly by the action which results from the logs in the various

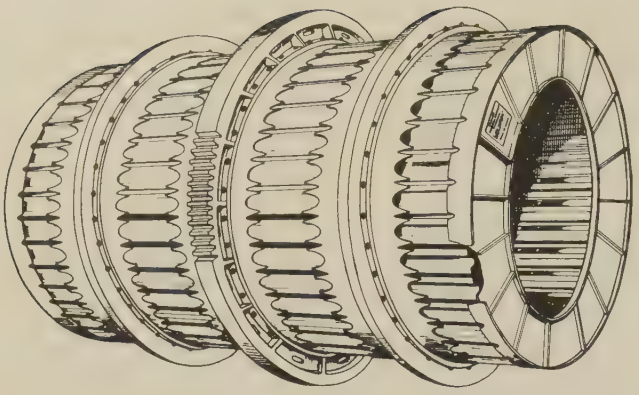

Fig. 1. Line drawing of modern welded barking drum

sections, having to change their direction when proceeding from one section to another. This construction utilizes drum shells of cylindrical plate design with riveted joints and no bark slots. Arrangement for the bark removal is incorporated in the 4-inch annular space between each drum section, and a similar space between the discharge section and the discharge head. Under certain types of operation, this design appears to give favorable results. There are two tires per section, each tire revolving on two fixed rollers and these rollers provide the necessary drive instead of using drum gears as is commonly the case.

Channel Stave Barking Drums

Another type of welded steel barking drum is the Murray Branch-Waterous design in which longitudinal staves made from 12-inch chip channels are fitted into slots in the circumferential members, such as the tires, gears, and end rings. In this design the circumferential members are of cast steel construction, while the longitudinal stave members are of structural steel material. As much of the loading as possible is arranged to come between the metal-to-metal fits of the longitudinal and circumferential members, while the welding is minimized to such locations where it is required to lock or maintain in position the constituent members. Because of the difference in steel materials involved, special precautions are necessary in the welding technique which is used.

A further development of this design includes the use of tapering filler pieces which are welded in between the channels in such a way as to reduce as far as possible the sudden change in loading of the longitudinal staves which occurs where the stave leaves the circumferential member.

The development of the practice of using such tapering filler pieces between staves has culminated in a patented system of applying such wedge-shaped pieces to many drums of this type of construction. These wedges were originally made about 3 inches long, but because of the improvement which their introduction permitted, the length of such wedges has gradually been increased to lengths of about 18 inches. These wedges fitted between the channel stave members and securely welded into place perform the twofold function of stiffening the entire cylindrical unit and, at the same time providing a more gradual distribution of the loading from the circumferential to the longitudinal members than was the case before such wedges were used.

Special U and M Bar Stave Barking Drums

The stave design of drum is also found in the type manufactured by Fiber Making Processes, Inc. of Chicago, and its Canadian affiliate, the Horton Steel Works Ltd. of Fort Erie, Ont. These drums consist of a series of longitudinal members in the form of specially rolled U or M-shaped staves assembled into circumferential members, consisting of rolled shells and rings. These circumferential and longitudinal members are suitably secured to one another by a combination of riveting and welding. The rivets in this case serve to hold the parts together, while the welding is arranged as a locking medium, thus forming a solid rotating unit. The location of the welds in this design are mostly parallel to the axis of the drum, while circumferential welds or welds across the stave members are avoided as far as possible.

This design of drum is generally supported and driven by chains and is frequently operated partially submerged in a tank of water to provide the necessary washing action on the logs.

Recent Design of All-Welded Steel Barking Drums

One of the most interesting developments in barking drum design which has been produced during recent years is the all-welded construction now used by Canadian Ingersoll-Rand Co., Ltd. at their Sherbrooke, Que., plant, Canada. This design was first used about 4 years ago having been inaugurated after a considerable period of study of the underlying principles of barking drum shell construction and fastening technique. The preliminary investigations made by this manufacturer embraced consultations with leading welding authorities such as Lincoln Electric Co., Air Reduction Co., Dominion Welding Engineering Co., etc.

Included in the investigations was an analysis of welding practice used for other important welding projects including the welding technique utilized for naval vessels. The Ship Structure Committee of the U. S. Navy issued a publication in July, 1946, entitled "The Design and Methods of Construction of Welded Steel

Fig. 2. Specimen of welding on outside of drum

Merchant Vessels." This book contains a very interesting story of welded steel ship construction and reports in detail investigations into structural failures of welded steel merchant vessels.

As many know, early attempts to build ships by welded connections resulted in failures, and these failures evidently occurred in the vicinity of the deck hatches where changes in sections are severe and where loadings tend to concentrate, particularly during the pitching of the vessel in rough weather.

Investigations were also made into the welding technique used for the fabrication of material-handling devices where it had been found that early attempts to weld directly across the lines of loading frequently resulted in failure. These failures being due to either the effect of the welding on the material welded or the fact that the presence of the weld caused a severe change in the section, and thereby localized the stresses to such an extent that when severe shock loads were encountered, the load values went beyond that which the weld or the material could stand. To overcome such failures, welding designers eventually learned to depart from the "across-the-section" weld and to substitute a diagonal welding pattern in the form of a long tapering V which apparently had the dual advantage of lengthening the welded joint and of reducing the load per unit of weld length, while also removing the sudden difference in sectional dimensions which is very likely to have been contributory to the failure by localization of load and stress.

An endeavor was made by the designers to analyze the load distribution and transmission pattern encountered in barking drums and to incorporate in an all-welded design the beneficial features which these other designers had found necessary in order to make their welded structures function satisfactorily.

The following basic principles were, therefore, suggested:

1. All welding should be done either in a longitudinal direction or in a diagonal direction.
2. No welding should be done in a direction at right angles to the axis of the drum shell.
3. The pattern of the various joints between the circumferential and longitudinal members should be such as to avoid quick change in section, and instead long tapering constituents, should be used, so as to gradually distribute the loads from the circumferential members of the longitudinal members and vice versa.
4. Because of the difficulty of stress relieving a unit of this size, the construction should be such that the welded joints will not cause large accumulations of locked-in welding stresses, but rather that some freedom of movement be possible in the joint design, so as to minimize the tendency for stress build-up.

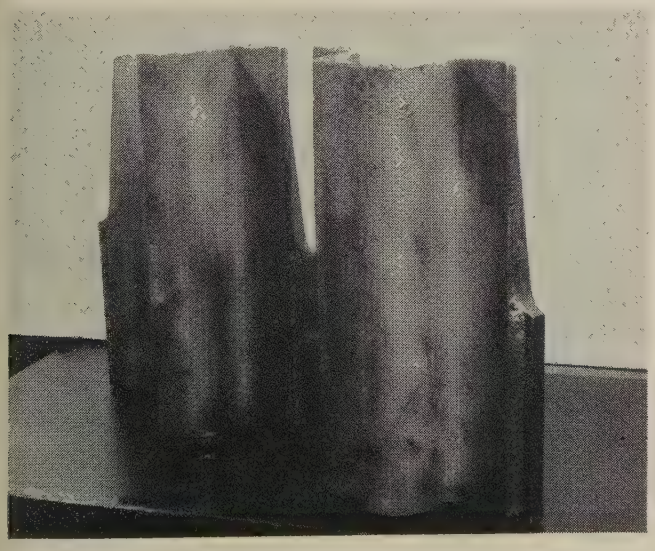

Fig. 3. Specimen of welding on inside of drum

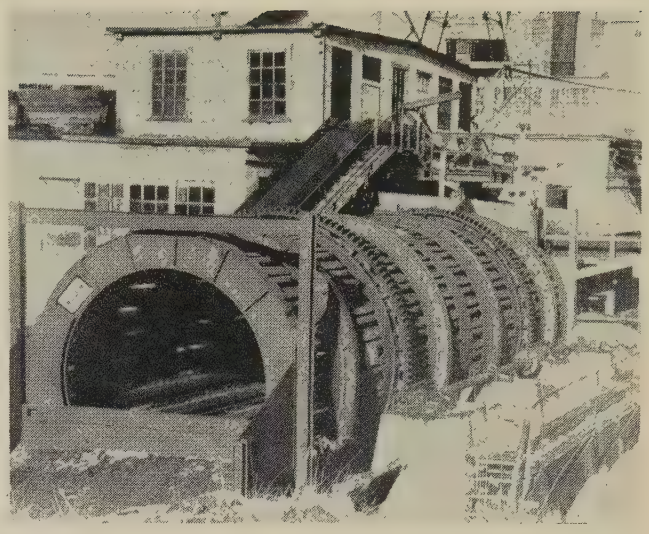

Fig. 4. Completely erected 12 by 45 foot Weldrum

DESIGN FEATURES OF ALL-WELDED BARKING DRUM

Longitudinal Members or Staves

The design now used by this manufacturer which was finally produced as a result of the foregoing investigations consists of a series of longitudinal steel staves of a specially designed section having wide flanges where the staves come in contact with the circumferential members. These staves are used in groups of 32 per circle, in the case of a 12-foot diameter drum and are $12^{3}/_{4}$ inches wide across the flanges, the thickness of the steel is $^{5}/_{8}$ inch. For 10-foot drums, there are 28 staves $12^{3}/_{4}$ inches wide across the flanges. This stave design is known as the Isherwood type and was originally produced for shipbuilding work because of the relatively high section modulus value which it provides in the direction of either axis. The same stave section had previously been used successfully for a large number of riveted barking drums. Its previous principal advantage being its adaptability to riveted construction, and also its ability to give high capacity barking without "brooming" of the logs. The use of this design of stave also gave the designer some degree of protection in the initial structures in that had the welding proved other than successful, some amount of auxiliary riveting could have been utilized had it been necessary.

Using the knowledge gained by investigations into the basic fundamentals of welded barking drum design, and keeping in mind that severe changes in loadings with their consequent stress concentrations should be avoided, an endeavor was made to find some means of tapering off the loadings and the weldings so that

whatever effects were produced by the welding would not be located at points where loads and stresses were such as to cause failures.

Circumferential Members or Drum Plates

In an endeavor to provide greater rigidity in the circumferential direction, it was decided to use circumferential members in the form of relatively wide plates, so that the torsional stresses from the gear drives and the supporting members could be more gradually distributed into the longitudinal stave members. These wider plates gave a greater leverage in the direction of rotation than could be obtained with narrower structural channel members. The added advantage was also procured of having these wide circumferential drum plates give protection against bark and dirt, as these plates provided some considerable coverage for the supporting compensating beams and rollers. The bark and dirt were, therefore, directed away from these supporting mediums.

Drum Plate Fingers

In the application of the design principles which had been established by the investigations, this manufacturer decided to utilize edges for the circumferential plates so that they would become a series of projecting fingers which could be welded to the flanges of the longitudinal staves in such a way that the loadings from the circumferential plates could be transferred gradually to the staves by these tapering fingers. This design accomplished the removal of abrupt changes in section and consequent loading which results from a plain-edge circumferential member.

By using these tapering fingered edges on the circumferential plates, it was possible to develop a welding technique which could taper the size of the welding bead used so that it would run out to zero at or near the end of each tapering finger.

By using this welding pattern a very fine opportunity was obtained of utilizing a reasonably large and long bead of welding, where the stave member came in contact with the circumferential element so that the welds could be restricted to the longitudinal direction only, and welding in a circumferential direction was thereby entirely eliminated. Circumferential plates of the above-described design were used under both gears and tires while the end heads of each section also had short circumferential plates into which the tapering finger idea was utilized to a minor degree.

Because of the magnitude of the structure involved, and the relatively high degree of experimental approach which this design incorporated, it was of course, necessary for the designers to keep as close as possible to a construction which had been previously used rather than to launch out into a completely new design program based only on generally accepted welding design principles. Using this degree of caution had the advantage of retaining in the design such valuable features as the stave section construction and endeavoring to build into these previously successful features the additional advantages which welding technique permitted.

Tires

In utilizing a drum plate construction of curved members with taper fingered edges, it was necessary to introduce into the tires sufficient additional section modulus to give the required rigidity and stiffness to ensure that the drum would remain a reasonably true circle. The total depth of the tire section was arranged to meet this requirement. Cast steel was originally used for these tire members, but fabricated tires of welded steel construction are now being employed.

Specification Characteristics

By arranging the design so that the steel members were all of a reasonably close specification, the selection of suitable welding rods was made easier. No welding had to be done to steel castings which usually presents a more difficult problem in securing suitable welding materials and welding technique, while the consistency of the steel plate specification is also an advantage in this connection.

Stress Relieving

Careful consideration was given into the necessity of otherwise stress relieving or annealing either the welds or the complete structure, or of preheating the plates before welding. It was finally decided, after consulting the various welding authorities involved, that if the welding connections could be suitably designed and the materials selected of suitable specifications, that stress relieving or annealing would not be necessary. Subsequent experience would seem to justify the decision that stress relieving was not necessary for the particular design which was selected.

Welding

In the case of 10-foot diameter drums the entire welding is done in the shop prior to shipment, but on 12-foot diameter drums, except for the shop welding of the end flanges or heads, the entire welding is done on assembly in the field. This, of course, necessitates that the welding be done by hand and the proper sequence of welding used so as to avoid as far as possible, heat concentrations, etc., which might cause warping of the various parts. Wherever possible downhand welding positions are used, and the drum rotated with an air motor hoist to bring the welding locations into favorable positions. Continuation of the inside longitudinal welds through to the outside welds down the edges of the fingers is arranged as carefully as possible to provide the continuity of weld tapering off to zero near the ends of the fingers.

Drums of This Design in Operation

The initial all-welded steel barking drum of this design was put into operation 4 years ago, and has operated successfully through four Summer periods, each of 6 months' duration without any signs of cracks or failures. During the initial operation of the first drum, careful inspections were made of the welds at monthly intervals, and subsequently, the welds have been examined at least twice during each season. It is rather remarkable to note that not a single crack has developed either in the weld or in any of the material.

Since the installation of the initial drum of this design, many similar drums have been manufactured and installed, and no failures of any kind have as yet

been reported, either in the welding or in the drum materials used.

There is, therefore, every indication that the maintenance costs which will result from the operation of this new design of all-welded barking drum will be in a much lower range than the maintenance costs which have resulted from drums of previous designs. As the cost of barking wood in barking drums is largely influenced by the maintenance charges on the barking drums, it is obvious that by the use of an all-welded drum construction, barking costs will be considerably lower than those obtained with many of the older barking drum designs.

Patents

The design used for the above-described barking drum being unique, patent applications have been made to cover same.

CONCLUSION

There can be very little doubt that the future development of barking drum design will tie in very closely with the steady flow of improvements which will be forthcoming in welding technique. The growth of the various welding associations, both in the United States and Canada, together with the keen interest which is displayed by welding material and equipment manufacturers, will undoubtedly play a large part in furthering the advancement of the process by education and other means.

As mentioned in the first part of this paper, the barking of pulpwood by barking drums has always been recognized as the cheapest barking process available, and the application of modern welding technique and design to barking drum construction will by virtue of the reduced maintenance involved, undoubtedly, prove an important factor in further reducing the unit cost of the barking operation.

In the foregoing paper, no attempt has been made to present an accurate record of all available barking drum designs nor even a complete picture of all modern improvements, but from the review that has been made of representative designs embracing these recent investigations, it is hoped that the author may have contributed something to the general knowledge available in this field of pulp and papermaking apparatus.

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Moisture Determination in Paper By Oven Drying

G. BROUGHTON and A. K. HOBBS

Methods of moisture determination on small samples of paper are reviewed with particular reference to oven drying. Sources of error are discussed critically. Results on cage and weighing bottle methods in free convection air ovens are presented for a number of papers. Oven temperature was maintained at 105°C. It is believed that the results are indicative of the precision that can be expected in normal, routine work.

A YEAR ago the Chemical Methods Committee of TAPPI was asked to review the standard methods for the determination of moisture in paper. As a result, a considerable amount of background material and experimental data has been accumulated. It is the object of this paper to present this for consideration preparatory to rewriting the standard T 412 m-42. In this way members can be fully conversant with the considerations guiding the committee members when the standard was tentatively rewritten and have the data in mind when voting on the proposed standard.

Moisture can be present in paper in a variety of forms, held with varying degrees of affinity. It may be held mechanically, absorbed as mono- and multimolecular layers, while capillary condensation may be a factor. It is not inconceivable, particularly in pulps where hemicelluloses, pentosans, etc., may be present, that water may actually be formed by internal reaction during the process of estimation. The possibility of reaction or decomposition of constituents of the paper, such as filler, dyes, sizing materials, must also not be neglected. Hence, there is a need for careful consideration of the moisture determination method if precise results are required. In general, the moisture content found will vary with the method of determination adopted.

Methods of drying are many. Besides direct oven drying at temperatures in the neighborhood of 100°C., which is the primary consideration of this paper, vacuum desiccation at room temperatures, oven drying at reduced pressures, infrared and dielectric heating, titration with Karl Fischer reagent, distillation with an immiscible solvent, electrical methods based upon changes in dielectric constant, and electrical conductivity have all been suggested in the literature. Oven drying is the subject of TAPPI Standards T 412 m-42, T 210 m-45, T 18 m-47 while distillation with an immiscible solvent forms the basis of Standards T 208 m-45 and T 3 m-44.

Recently the Technical Section of the Paper Makers Association has given careful thought to sampling and testing paper for moisture content (*1*) and has issued a new standard (*2*). The Cellulose Section of the American Chemical Society has also made interlaboratory tests on proposed methods for the determination of moisture in cellulose (*3*). In any appraisal of a testing method there must be considered (1) the method of sampling and the errors involved therein, (2) possible change in the quantity determined between the time of taking of the sample and the time of determination, and (3) the analytical error of the determination being considered. The present paper deliberately avoids factors (1) and (2), and attention is focused on (3). When this is done, comparison of the oven-drying

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Table I. Comparison of Proposed Methods for Oven Drying

Society	Suggested use	Sample size	Details	Precision claimed
TAPPI T 412 m-42	Paper, paperboard, etc., not containing materials other than H_2O volatile at 105°C.	Not less than 1 gram—preferably	1–2 hours at 100–105°C. Air circulation specified with dried air preferred. Weighing bottle or can	Duplicates agree to 0.2%
TAPPI T 210 m-45	Wood pulp, wet laps, etc.	...	99–103°C. in any "suitable oven"	Duplicates agree to 0.1%
TAPPI T 18 m-47.	Pulpwood	300–350 grams	24–48 hours at 105 ± 3°C. in "drying oven." Wire mesh tray or basket	...
Tech. Sect. PMA	Paper, paperboard, etc., not containing materials other than H_2O volatile at 105°C.	...	Not less than 1/2 hour at 102–105°C. Air circulation specified. Weighing bottle or can	Duplicates agree to 0.1%
ACS	Cellulose except samples containing materials other than H_2O volatile at 105°C.	10 grams	2 hours at 105 ± 3°C. in oven with stream of dry air 4 hours at 105 ± 3°C. in oven with no air stream. Use basket in weighing bottle or special oven with basket or shallow pan	Duplicates agree to 0.1%

methods suggested (*1*, *4*) with the present TAPPI Standards leads to Table I. In this table, for purposes of comparison, certain pulps are also included although it is recognized that the same methods cannot necessarily be used for pulp and paper.

It will be seen that considerable variability in the methods suggested exists and it would seem desirable that more uniformity, bearing in mind any special conditions that may exist, be attained.

THE VARIABLES IN OVEN DRYING

It would appear that any specification covering oven drying of paper or other cellulosic material should specifically consider and define: (1) the conditions of air circulation in the oven; (2) the time of drying; (3) the temperature of the oven; (4) the size and condition, i.e., folded, cut into small pieces, etc., of the sample; (5) the container in which the sample is dried; (6) the humidity of the air used; and (7) the conditions under which the sample is held before final weighing.

Most of these factors are interrelated. Drying takes place at a finite rate and for rapid drying there must be good heat transfer to the sample followed by rapid removal of the water vapor formed. Mitchell (*5*) has recently made an experimental study of the rate of evaporation of water in drying ovens and points out the variations which can be obtained by changing circulation rate. It is clear that if a time of drying is specified circulation conditions must also be defined.

Moisture content indicated increases with temperature as shown in Table II (*1*) where the samples were dried for 2 hours at the indicated temperatures. The importance of specifying temperature is apparent although there is no reason for rejecting the present specified temperature of 100 to 105°C.

Prolonged drying does not lead apparently to serious trouble from "over-drying" as shown in Table III (*1*). Hence, no fear need be felt in rechecking samples to constant weight except perhaps in some special cases.

Table II. The Effect of Temperature in Oven Drying Upon Moisture Test Results (*1*)

	98 ± 2°C.	*107 ± 2°C.*	*123 ± 3°C.*
Kraft wrapping	8.1%	8.5%	8.8%
Newsprint	7.7%	8.3%	8.6%
Sulphite wrapping	7.4%	7.9%	8.1%
Esparto printing	7.1%	7.4%	7.7%

It seemed conceivable that the form in which the paper was cut and inserted into the container for drying might have some influence upon drying rate if not upon moisture content. This was checked by drying paper in strip form 3/8 inch wide and as a sheet roughly folded and placed in a weighing bottle. Both samples were kept in their open weighing bottles throughout the oven-drying operation. Results are shown in Fig. 1 indicating that this factor is of little importance. The final moisture contents were 7.72 and 7.58%, respectively. In order to be certain that final moisture contents were not affected, five samples of blotting and bond papers were run—average moisture contents of cut and uncut samples were 7.72 and 7.67% and 6.08 and 6.20%, respectively, indicating no significant difference.

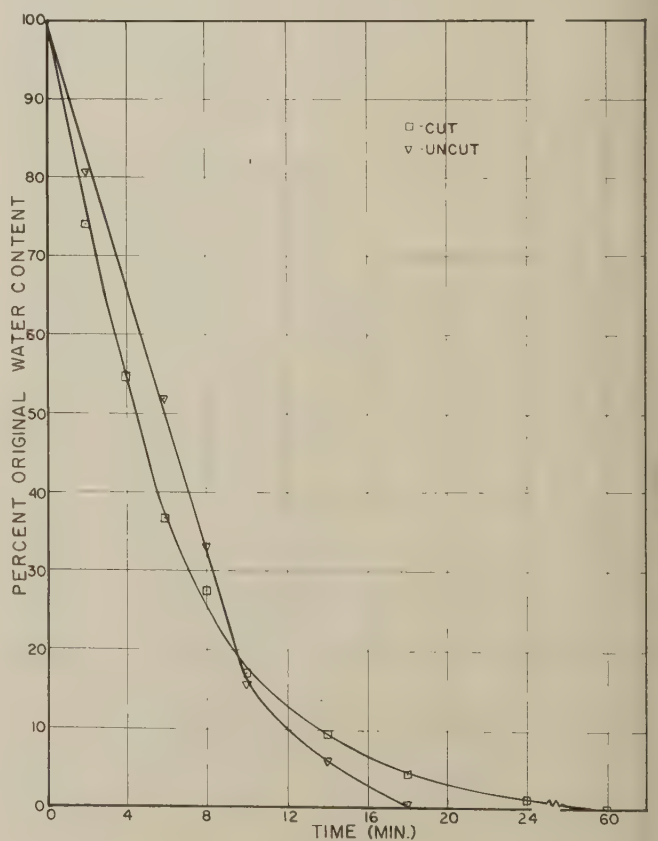

Fig. 1.

Table III. The Effect of Prolonged Drying Upon Moisture Test Results (*1*)

	2 hours	*6 hours*	*14 hours*
Kraft	8.73	8.73	8.88
Newsprint	8.22	8.22	8.51
Sulphite	7.93	7.88	7.93
Esparto	7.51	7.50	7.59

The new British specification (*2*) calls for the sample to be removed from its container during the actual drying period in the oven in order to allow free exposure of the entire surface of the sample. Alternatively, it is suggested that a double-ended container may be used, top and bottom lids being removed during the actual drying operation. The American Chemical Society tentative specification (*4*) states: "Experience has shown, however, that when samples are left in the weighing bottles in the oven comparatively discordant results are obtained and the drying period is relatively long." For this reason the specification calls for the use of a wire basket, which may be lifted out of the weighing bottle during drying and reinserted before weighing. It appears that this point may require further investigation for paper and more experimental work is planned.

In the tests conducted by the American Chemical Society Cellulose Section (*3*) considerable attention was paid to the differences observed when dry and ordinary undried laboratory air were used for circulation through the oven (Table IV). A common sample was subdivided and sent to a number of laboratories. It will be seen that while the precision with undried air was no worse than with dry air, the average result was somewhat lower. They concluded "the moisture level determined with and without a current of dried air is significantly different and the lower results secured with undried air are believed to be inaccurate." The absolute difference was 0.2%. While this is undoubtedly a real effect we are inclined to believe that the small differences involved do not justify the use of the more elaborate oven with drying train that is required for the use of dry air. The British specification does not call for dry air.

Conditions under which the dried sample is kept before weighing are important. Anhydrous cellulose is very hygroscopic, moisture-free paper picking up approximately 4% of moisture or 55% of its total regain in 1 minute when exposed to air moving at 3 feet per second (*1*). The need for protection of the dry sample from moisture is evident. There appears to be no reason to question the ACS tentative standard which places the weighing bottle directly from the oven to an appropriate desiccator after the stopper has been inserted.

Table IV. The Effect of Air Dryness Upon Moisture Test Results (*3*)

Laboratory (Coded)	*1*	*5*	*7*	*8*	*9*	*10*
A. Oven Supplied with Dried Air						
Results	10.86	10.72	10.98	10.55	10.96	10.94
	10.89	10.69	10.89	11.05	11.02	10.93
	10.93	10.30	10.84	10.85	10.72	10.89
	10.99	10.40	10.96	10.95	10.73	11.01
Average	10.92	10.53	10.92	10.85	10.86	10.94
Range	0.13	0.42	0.14	0.50	0.34	0.12
Laboratory...	*4*	*6*	*11*	*12*		
B. Ovens Supplied with Normal Laboratory Air						
Results	10.64	10.91	10.61	10.67		
	10.64	10.76	10.63	10.69		
	10.68	10.81	10.61	10.54		
	10.73	10.72	10.63	10.73		
Average	10.67	10.80	10.62	10.66		
Range	0.09	0.19	0.02	0.19		

Table V. Precision of Oven-Drying Method

Weighing Bottle Method

A. Wrapping paper (Kraft)
Results: 8.42, 8.24, 8.52, 8.39, 8.11, 8.33, 8.24, 8.44, 8.19, 8.32
Average: 8.32%; range 0.41; standard deviation 0.12

B. Bond paper (25% Rag)
Results: 7.64, 7.63, 7.83, 7.61, 7.53
Average: 8.67; range 0.30

C. Blotting paper
Results: 5.93, 6.10, 6.27, 6.13, 6.41, 6.37
Average: 6.20; range 0.48

Oven Balance Method

D. Kraft paper
Results: 8.92, 8.92, 8.88, 8.66, 8.74, 8.81, 8.69, 8.95, 9.00, 9.00
Average: 8.85; range 0.34; standard deviation 0.12

PRECISION IN OVEN DRYING

Having discussed the variables involved in the method, it is of interest to estimate the precision attainable. A series of tests were made using an oven at 105°C., natural circulation through the oven of laboratory air controlled at 65% R. H. and 70°F., and using the weighing bottle method without removal of the sample from the bottle during drying. Constancy of moisture content of the different samples of paper was insured by conditioning at 65% R. H. and 70°F. in a controlled relative humidity room, followed by weighing in the same room before and after drying. In this way changes in moisture content between taking the samples and weighing them were minimized. The results are shown in Table V. Each series was run by a single operator.

These results are believed to be typical since they are of the same order of magnitude as those cited in Table IV and also those reported by the Technical Section of the Paper Makers Association (*1*). It is felt, therefore, that under good conditions; i.e., no sampling errors, etc., even without withdrawal of the sample from the weighing bottle or the use of dry air, duplicate determinations should be within 0.2% and that a standard similar in nature to the British standard should be satisfactory for most work.

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Problems in Testing Wet-Strength Paper

C. S. MAXWELL

The problems of testing wet-strength papers and in reporting and interpreting the results obtained are discussed. The pH of the saturating water is an important factor in determining the rate of hydrolysis of the wet-strength resin with the resulting loss of wet strength. It is pointed out that unbuffered (e.g., distilled) water tends to assume the pH of the paper soaked in it and may give erratic and misleading results, whereas buffered waters maintain their original pH and give much more reproducible results. Rosin sizing itself imparts some wet strength, but at the same time, complicates the testing procedure by requiring a longer time for complete saturation—during which time a loss of true wet strength can simultaneously occur. It appears feasible to use a wetting agent on such papers for routine control provided its effect on the test has been previously established. The problems of correlating off-machine, natural, and accelerated aging data are discussed as well as the various methods used in reporting results.

Paper is inherently a difficult material to evaluate for strength properties because of its non-uniformity. This is aptly illustrated by the common practice of retesting paper reels that are below standard on original control test, but which are often acceptable based on the retest. While it may be debatable whether the retest is any more correct than the original, it is generally agreed that if a sufficient number of tests are made, the physical properties of dry paper can be determined with reasonable accuracy.

If this simple statistical approach is carried over to the determination of the wet-strength properties (e.g., wet tensile, wet burst or, wet rub) it is found inadequate. Some of this inadequacy is due to lack of precise definition of terms and some to the dynamic nature of the wet-strength properties in which not only the degree of wetting of the paper, but also the state of cure or state of hydrolysis of the resin in the paper affect the strength tests.

Braums (*3*) has reported in some detail on the effect of soaking conditions on wet strength, but very little data have been published where close attention has been given to state of cure or hydrolysis of the resin.

EFFECT OF BUFFERED VERSUS UNBUFFERED WATERS

In the determination of wet tensile strength by the TAPPI method (*1*) saturation with distilled water or equivalent is specified. The reason for this choice was that the constituents of tap or natural waters vary, so such waters may be acid or alkaline, buffered or unbuffered, depending on the source. Distilled water, while it may be objectionable in some respects, as discussed later, at least should be fairly uniform.

To determine the effect of various "waters," strips of wet-strength paper were soaked in demineralized (ion exchange) water, and in natural and prepared salt solutions at 73°F. These strips were withdrawn and tested for tensile strength (wet) at intervals over a period of several months. The resulting data, which are based on paper treated with an anionic urea-formaldehyde (UF) resin, are shown in Fig. 1.

It is clearly evident that the wet strength was lost most rapidly in demineralized water, and least rapidly in the natural salt (sea) water. As the various synthetic salt waters (Na_2SO_4, $MgCl_2$, and NaCl) were between the two extremes in behavior, but more nearly like the demineralized water, it was concluded that the pH and buffer capacity of the system, rather than the salt content, were more likely to be the critical factors. Thomas (*2*), Britt (*3*), and Braums (*4*) have already reported that melamine and urea resin treated papers lose wet strength faster when soaked in buffer solutions at low pH than when subjected to buffers at higher pH, and this approach is widely used in recovering wet-strength broke (*5*).

Following the method of Clark and Lubs (*6*) a num-

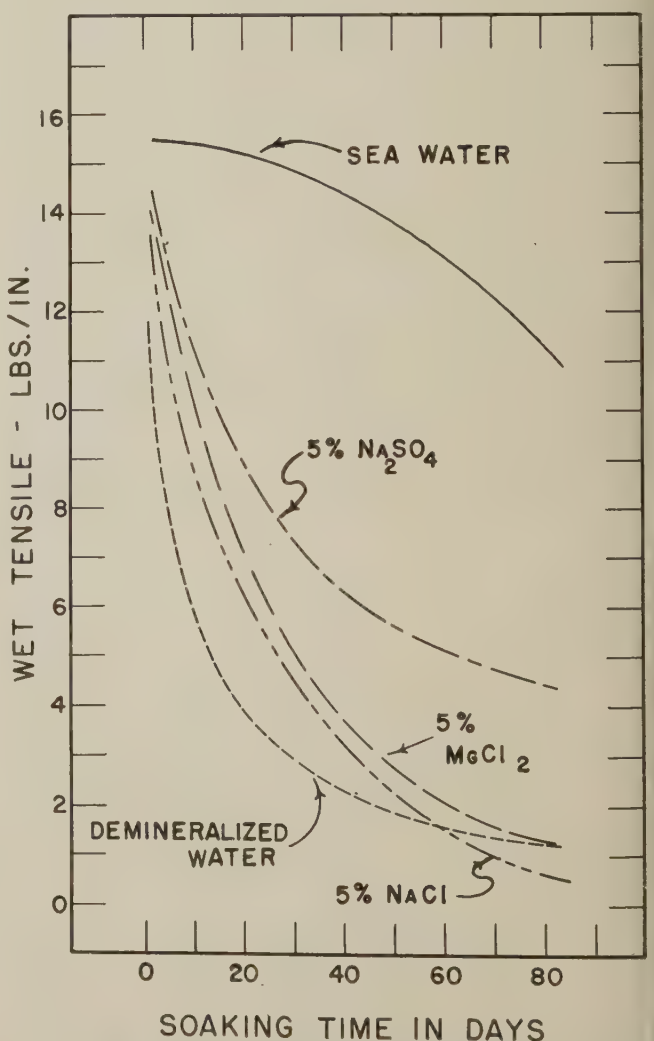

Fig. 1. Effect of natural and synthetic salt solutions on wet strength (anionic UF resin)

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Table I. Effect of Soaking Time on Wet Tensile Strength

Resin treatment (3% on fiber)	*Test No.*	*Loss of wet strength, %*[a]
Melamine acid colloid	A	12.4
	B	6.1
	C	5.3
	(Av.—MF resin)	(7.4)
Cationic UF resin	D	17.2
	E	11.4
	F	23.3
	G	13.0
	(Av.—Cationic UF resin)	(16.2)
Anionic UF resin	H	32.4
	I	29.0
	J	20.0
	(Av.-Anionic UF resin)	(27.1)

[a] % Loss of wet strength = $\frac{\text{Tensile strength after 10 min. soak} - \text{Tensile strength after 16 hr. soak}}{\text{Tensile strength after 10 min. soak}} \times 100.$

ber of buffer solutions were prepared from potassium acid phthalate or potassium di-acid phosphate, over the range of pH 8.0 to 4.0. Wet-strength paper strips, cut for the Schopper-Riegler tensile tester, were soaked in the buffers at 73°F. and tested at intervals for tensile strength.

Typical hydrolysis curves are obtained from paper treated with an anionic UF resin (Fig. 2) and with a cationic UF resin (Fig. 3). Similar curves, but with less slope because of the slower rate of hydrolysis, are obtained from paper treated with melamine acid colloid.

One thing that shows up very strikingly in Fig. 2 is the wide spread in the initial wet-strength values. These particular values were obtained after the paper had been saturated for 16 hours which period has been routinely used at our laboratories for saturating wet-strength papers. Before setting this up it had been determined experimentally that for papers treated with melamine resin this period, with demineralized water, gave results not significantly different from those obtained after a 1 to 2-hour soak. For convenience, the cut samples are routinely put to soak at 5 p.m. and tested between 9 and 11 a.m. the following morning.

It has previously been reported by Britt (*3*) and again by the author (*7*) that in buffer solutions at the same pH and temperature, papers treated with melamine resin retained their wet strength longer than papers treated with urea resins. The comparison of the wet strength of such papers after soaking in distilled (or

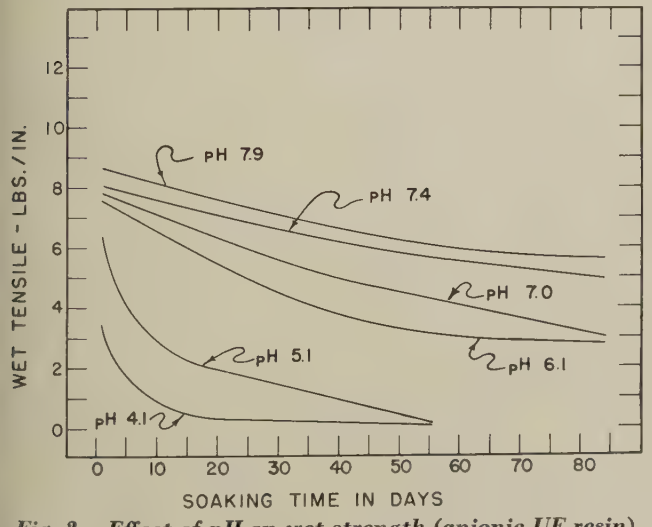

Fig. 2. Effect of pH on wet strength (anionic UF resin)

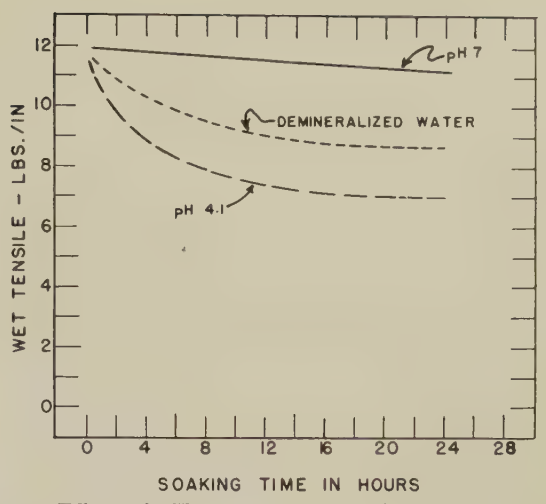

Fig. 3. Effect of pH on wet strength (cationic UF resin)

demineralized) water for very short times and for longer periods was obviously of great interest. Therefore, papers treated with melamine resin acid colloid, cationic UF and anionic UF resins* were divided into duplicate sets and soaked in demineralized water for 10 minutes and 16 hours, respectively, the tensile strength (wet) being determined at the two intervals. A number of such comparisons were made, involving differences in pulps and sheet weights but in all cases free of rosin or other sizing agents. The results of these comparisons are shown in Table I, in which the per cent loss of strength between the 10-minute and 16-hour values are given.

It is apparent that, while some loss of wet strength has occurred in all cases during the soaking period from 10 minutes to 16 hours, the loss is relatively small in the case of the melamine resin treatment, is appreciably greater for the cationic UF-treated, and is most serious for the anionic UF-treated papers. Because these sheets were unsized and wet rapidly, it is presumed that most, if not all of the observed loss in strength is due to hydrolysis of the wet-strength resin used.

The demineralized water used to saturate the samples is essentially free of dissolved solids and is considered equivalent to distilled water for this particular purpose. Being unbuffered, its pH changes readily to conform to that of the paper immersed in it. If two similar wet-strength papers that differ only in pH are immersed in separate portions of such water, the papers are actually being soaked under different pH conditions and the loss of wet strength will be more rapid at the lower pH. To prevent such a factor from possibly affecting the results illustrated in Table I, the several papers were soaked simultaneously in the same container of water.

* The resins actually used were PAREZ ®Resin 607 (MF), Parez Resin 610 (anionic UF) and Parez Resin 614 (cationic UF) produced and sold by American Cyanamid Co. It is not necessarily implied that all other resins that can be classified in these three groups would behave exactly as these three specific resins. All test data reported herein are based on papers treated with 3% of the various resins.

Table II. Effect of Rosin Size on Wet Strength

Stock treatment[a]			*Tensile strength, lb./in.*	
(1)	*(2)*	*(3)*	*Dry*	*Wet*
Alum	...	...	27.3	1.2
Rosin size	Alum	...	26.3	3.5
Alum	Melamine resin	...	33.6	8.6
Rosin size	Alum	Melamine resin	33.7	11.0

[a] 3% of each material.

Table III. Effect of Wetting Agent

	(Wet) tensile strength, lb./in.			
	10-min. soak		16-hour soak	
	Water	0.05% Aerosol OT	Water	0.05% Aerosol OT
Melamine acid colloid	9.8	9.6	9.2	9.0
Cationic UF	12.2	11.8	10.6	10.1
Anionic UF	10.2	10.4	7.0	7.3

It should be pointed out, however, that this simple expedient is not always applicable under mill control testing conditions, because of time and location differences.

EFFECT OF SIZING AGENTS

The problem of wet-strength testing becomes more complex when sized papers are involved, for the soaking period has to be sufficiently prolonged to overcome the sizing effect but not long enough to cause hydrolysis of the wet-strength resin. In some cases, it is probable these two effects actually overlap.

Rosin size, itself, imparts a small but measurable wet strength to paper. The magnitude of such wet strength compared to that imparted by melamine acid colloid resin is shown in Table II. The test samples were soaked for 16 hours so that the water resistance property of the sized paper was not a factor in the test. However, there are some proposed sizing tests and a number of use tests where the two properties (sizing and wet strength) are measured jointly as a mixed result. The sizing test proposed by Wilson (*8*) in which strips are suspended in water under different loadings is such a test as both the water resistance and wet strength affect the results. It is quite correct that in many end uses a hard sized paper may have sufficient "wet strength" simply because the paper is not completely saturated under the use conditions.

Some mills have found it expedient to use a wetting agent to destroy the effect of sizing agents so that the true wet strength can be measured without a long soaking period. There can be no objections to the use of such an agent for routine control provided the user is satisfied that the wetting agent used does not affect his results, or if it does, knows what correction factor to apply. Braums (*4*) reports that some wetting agents gave unreliable results. A quick survey of the effect of an anionic agent† on several available wet-strength papers—none containing rosin size—is shown in Table III. No adverse effect of the wetting agent is evident.

† AEROSOL®OT surface active agent.

EFFECT OF STATE OF CURE

In the production of wet-strength papers the papermaker is faced with a dilemma: he wants a paper that develops as much of its potential wet strength as possible right off the machine, but at the same time he would like to recover his broke easily. At the present state of the art, these two aims are incompatible. However, wet-strength resins vary widely in rate of cure bringing up the problem of how and when to test papers containing them. Should they be tested right off the machine, after an accelerated aging period, or after a period of normal aging? Many operators have found that by trial and error they can find some rapid curing procedure that will closely approximate the cure obtained after a specified period of natural aging—provided that the resin, grade of paper, and machine conditions are kept constant. However, the particular accelerated curing procedure found satisfactory under one set of conditions will not necessarily hold for others. As more data are accumulated on the various factors involved it may eventually be possible to predict the wet strength that will develop in any grade of paper. As this state of affairs has not yet been reached each paper manufacturer must rely on his own correlation between off-machine and naturally aged samples. In general, the melamine acid colloid resin develops its potential wet strength appreciably faster than do the urea resins, but in almost all cases, complete cure is not obtained directly off the machine.

PROBLEM OF REPORTING RESULTS

One additional problem which perhaps should be touched on briefly is that of reporting wet-strength results. The current TAPPI procedure (*1*) calls for reporting the wet strength as per cent of the dry tensile strength of the treated paper, and also the actual wet tensile strength in pounds or grams per unit of width. This double method was chosen after much deliberation as the best compromise possible. A number of other methods are used to report wet strength, and as long as the conditions and method of reporting are stated, may be even more useful than the TAPPI standard in

Table IV. Some Methods of Reporting Wet Strength

1.	% Wet strength = $\frac{\text{Wet tensile treated paper}}{\text{Dry tensile treated paper}} \times 100$	Does not compensate for increase in dry tensile strength that usually occurs with resin treatment	Together constitute the TAPPI Standard method of reporting (*1*)
2.	Wet tensile strength = Actual values obtained in lb./in. or kg./15 mm.	The value by itself is not indicative of the degree of wet strength	
3.	% Wet strength = $\frac{\text{Wet tensile treated paper}}{\text{Dry tensile untreated paper}} \times 100$	Measures change due to treatment but in many cases similar untreated paper is not available	
4.	% Wet strength = $\frac{\text{Wet burst}}{\text{Dry burst}} \times 100$	Same comment as method 1. In addition bursting strength not as universally applicable as tensile measurements	
5.	% Wet strength = $\frac{\text{Wet burst}}{\text{Basis weight}} \times 100$ (Points per pound)	Bursting strength not as universally applicable as tensile. Does not relate wet strength to dry strength	
6.	Wet strength = Wet rub resistance as measured by Aminco instrument	Excellent for use test if surface wet rub desired. Usually used in conjunction with wet tensile test	
7.	Wet strength = Wet rub resistance as measured by Tabor instrument		

certain applications. Some of these methods and the TAPPI standard method are shown in Table IV.

SUMMARY

To summarize briefly, it is evident that the problem of measuring and reporting the degree of wet strength in paper is not as simple as it appears at first glance. The time of soaking and the condition of the water used for soaking are important factors. The advisability of using water of a specific buffer content, rather than the distilled that is currently specified by TAPPI (*1*), should be seriously considered. For control purposes there should be no objection to methods of artificial aging, application of wetting agents, or the utilization of special end-use tests, provided the user realizes both the limitations of such tests, and their correlation with standard procedures.

The purpose of this paper has not been to offer specific methods to overcome the problems encountered, but rather to bring together the observations of a number of researchers so that everyone is aware of the problems and can pool efforts toward their solution.

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Hammermill Dirt Separator

E. L. RASTATTER and A. H. CROUP

The development of a centrifugal-type cleaning device for pulp and paper furnishes is described. This separator was designed specifically for the removal of small, low specific gravity, speck dirt. Details of the developmental procedure are given. Very good efficiency in the removal of impurities of both wood and nonwood origin is indicated. Long, slender shives are not effectively removed. The details of a small installation in operation for over 10 years are given and the plans for a commercial design based on the use of these units are described.

The cleaning of pulp and paper machine furnishes has taken on a considerably greater importance within recent years. The cost and the scarcity of labor make it impractical to clean the wood today as it was done 20 years ago. The interest in various auxiliary cleaning devices is evident by the increased literature on this subject (*1–4*).

For many years the pulp and paper industry has used rifflers for removing objectionable dirt particles from a pulp suspension. The ability of these rifflers to effect this separation depends on the foreign particles having either a higher specific gravity or a lower fluid friction than the fibers from which these particles were to be separated. Since it is impractical to attempt to lower the fluid friction, any improvement in gravitational methods of separating dirt particles must come from an increase in the effect of gravity. Thus, coarse heavy dirt, such as large grit and scale, can be removed by riffling, while other objectionable dirt having a settling rate close to that of the fibers is not affected by this procedure. One method that has been employed is based on the centrifugal principle whereby the fluid and particles are set into rapid rotational motion, increasing the force acting on the particles.

In some applications, such as the cream separator, mechanical means are used to set the fluid in motion, and a separation between two liquids of different specific gravities is effected. In other applications, the centrifugal action is obtained by tangentially introducing the liquid, under pressure, into a stationary circular chamber.

In equipment of this type, a pulp suspension, introduced tangentially at the top of a cylinder, causes the liquid to spin rapidly about the sides. As additional liquid continues to enter the chamber it moves downward where a fraction is removed. The remainder of the liquid, unable to escape at this point, forms a central ascending column, still spinning, which is removed from the chamber through a port centrally located in the top of the cylinder. Because of the rapid rotational motion of the fluid, the effectively heavier particles in the pulp suspension migrate to the outer edge of the spinning stream. The problem then becomes one of finding the proper design to most efficiently remove the liquid adjacent to the wall of the cylinder.

It is apparent that no turbulence within the spinning stream can be permitted after the centrifugal action has forced the heavier particles into the outer layer of the stream, and the fraction removed must be a reasonable percentage of the input volume. A long conical section satisfies these two requirements. It gradually crowds the heavier outer layer into a smaller and smaller cross-sectional area until small enough to be discharged.

The development of the Hammermill Dirt Separator* was aimed at the removal of the fine light dirt so difficult or impossible to remove by fine screening or riffling. As centrifugal separation, like riffling, depends on the dirt particle having an effectively greater specific gravity than the fiber from which it is to be removed, the relative settling rates of the fiber and the dirt particle in still water indicate very well the ease or diffi-

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* Licensed to and manufactured by the Bauer Bros., Springfield, Ohio, under U. S. pat. 2,377,524; Canadian pat. 429,584.

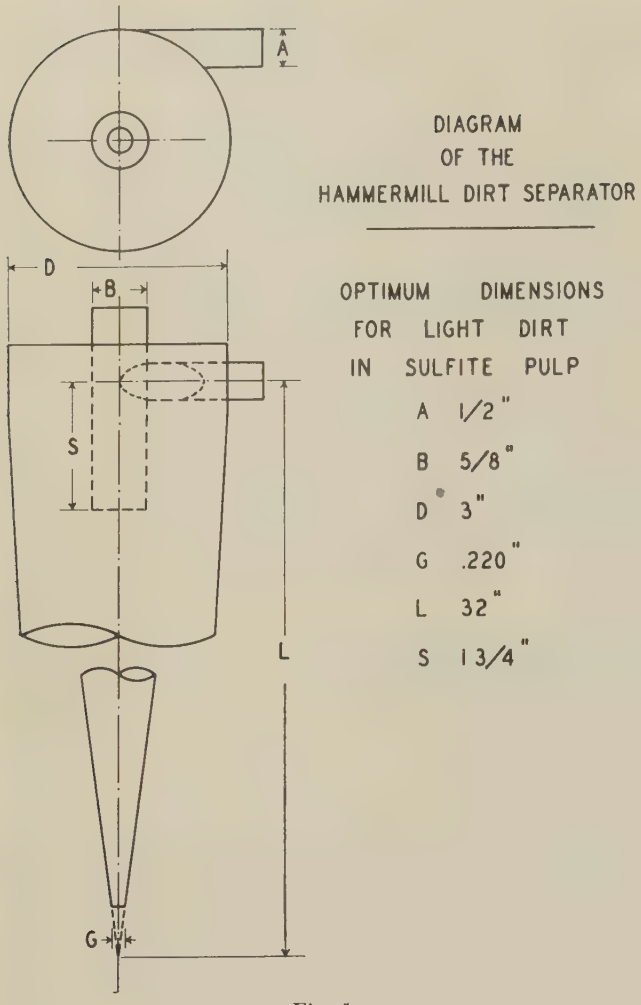

Fig. 1

culty with which the latter may be removed. Because pulp fibers behave in water as though their specific gravity were very close to 1.0 it is possible to remove foreign particles whose specific gravity is less than that of the fiber but which have a faster settling rate due to a smaller specific area.

The centrifugal pulp-cleaning devices on the market were studied, and a number of trials made in the laboratory "glassware" stage. All evidence pointed toward the desirability of simplification and streamlining of a basic tangential entry head on a long conical section. It was, however, felt that the relationship between the various dimensions might well prove critical. Therefore, the major effort of the investigation was centered on resolving the variables of a device as sketched in Fig. 1.

EXPERIMENTAL PROCEDURE

Early experimental work was done using water alone instead of a pulp suspension. Finely screened sand was used as the "dirt." Minor improvements soon made the cleaner so efficient that a ground and screened carnauba wax-rosin mixture was substituted for the sand. The laboratory glassware equipment gave way to soldered sheet metal which, in turn, was supplanted with seamless, spun copper cones and carefully machined inlet heads and outlets.

It was found early in these experiments that improving the dirt removal efficiency on "light" dirt automatically improved the efficiency on the removal of the heavier dirt particles as long as the general shapes of the particles remained similar. Thus, when changes improved the efficiency of dirt removal on the equivalent of small pitch spots, the efficiency on grit and cinders would be correspondingly increased. For this reason, the specific gravity of the manufactured "dirt" was lowered as the efficiency of the cleaner was improved because it was felt desirable to make the unit as efficient as possible for the removal of the most important and most difficult type of dirt, fine wood dirt. As the need arose, the percentages of wax and rosin in the mixtures were varied to give specific gravities of 1.036, 1.020, and finally 1.014.

This synthetic dirt was very carefully prepared to assure reproducible results. The mixture was ground and screened through 40 and retained on 60-mesh screens. The accepted particles were then made spherical by passing them through a flame and again screened through 40 and retained on 60 mesh. To avoid break-up the "dirt" was introduced into the experimental system after the pump and then collected in the accepted and reject fractions from the cleaner. When only water was used, the manufactured dirt collected was measured in settling tubes. When a pulp suspension was used in the experiment, handsheets were made of the two fractions and dried on a steam drum drier. This melted the wax and permitted the particles to be readily counted after wetting the sheet. To further improve the accuracy of the experimental procedure the sampling of the two fractions and the timing of the run were done mechanically.

As the variables were investigated in this experimental development, improvement in the dirt removal

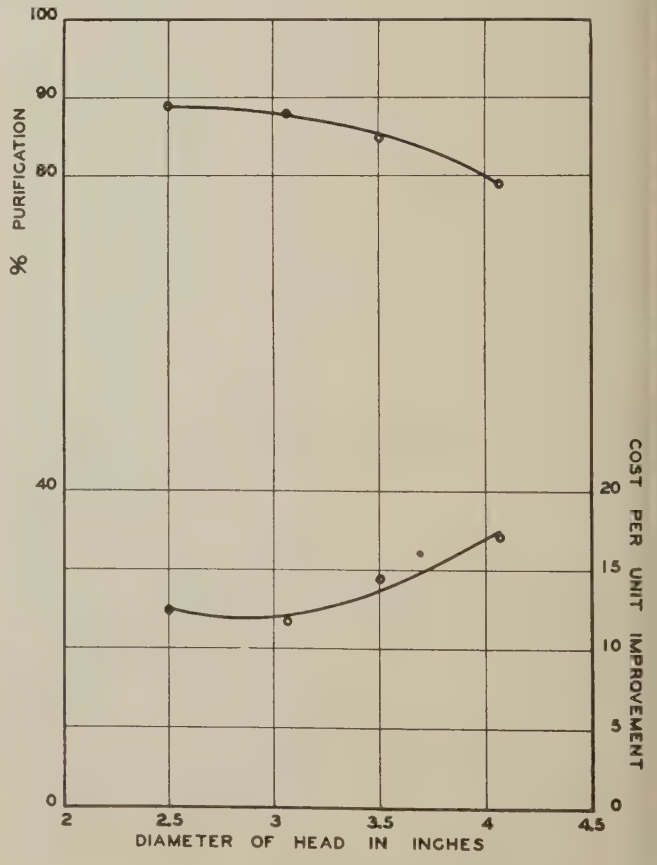

Fig. 2

efficiency could not be the only criterion. Actually, an increase in input pressure always improved dirt removal but at an increased cost. A careful study and estimate was made of the cost of operating the separator. This included investment cost, depreciation, maintenance, and attending labor, as well as pumping cost. The final measurement of improvement was then calculated as the cost of removing 50% of the "dirt" in a ton of pulp coming to the unit. In this calculation, a cleaner that removed 50% of the "dirt" from a ton of pulp for, say, 10¢ was of equal efficiency to a cleaner removing 75% (two units of improvement, 50% + 50%) for 20¢. Because the necessity of tailing the device rather heavily was anticipated, the cost efficiency calculated contained provisions for cleaning the pulp in the rejected fraction to the same cleanliness as the accepted fraction. In this manner variations in dimensions and in operating procedure and pressures could be put on a common basis and compared directly.

In commercial practice, the recovery of rejects is done in stages. The first stage operates on the incoming pulp; the second stage cleans the rejects of the first stage, etc. This is continued until the final rejects are a low enough percentage of the total to be discarded.

The early laboratory experimental work was done on a model with a $2^3/_4$-inch diameter head to keep the volumes and flows within the limits of reasonably

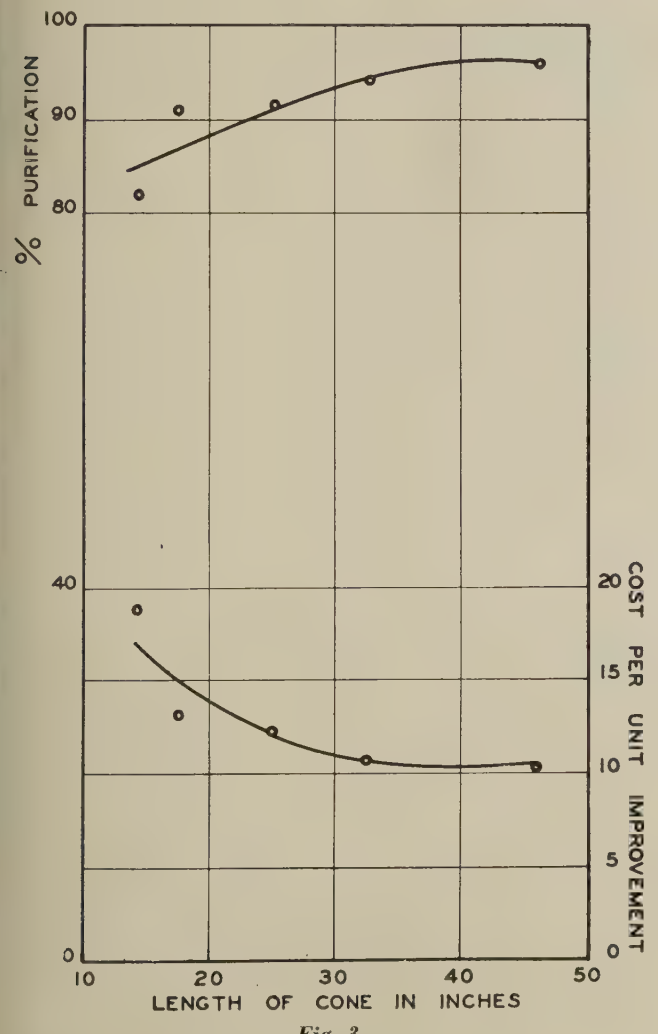

Fig. 3

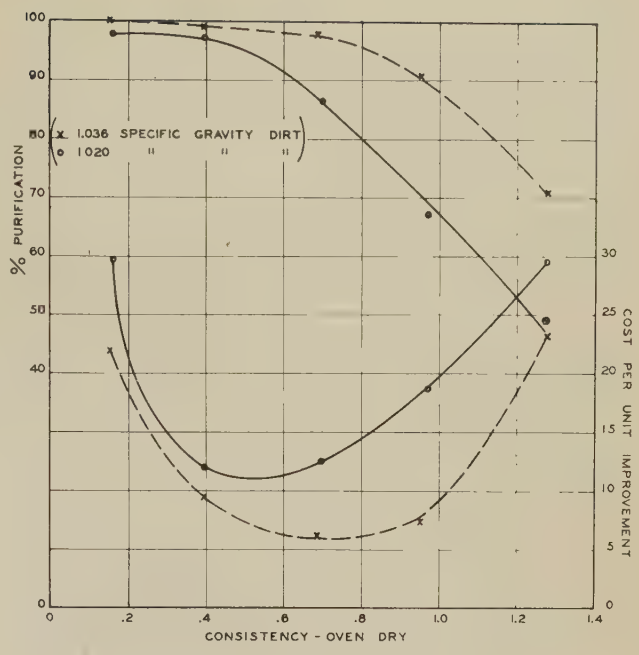

Fig. 4

sized laboratory pumps and tanks. The first well-machined model made was only slightly larger with a $3^1/_{16}$-inch diameter head to verify the results of the earlier model. It was, of course, hoped that the final development would be a large model with the 2, 4, or 6-inch pipe inlets and outlets which mill operating people like to see. After the proper relationship of the variables had been reasonably well established, four units were constructed. These varied from $2^1/_2$ to $4^1/_{16}$ inch diameter. Interchangeable parts were used where possible, and completely new units were made to evaluate the variable of diameter. With these units and parts it was possible to vary diameter only, and also to vary all other dimensions proportionally with the change in diameter. A great many intermediate variations were possible and were investigated. It was found that any increase in the diameter of the unit resulted in a decrease in both efficiency and purification in geometrically similar units. The $2^1/_2$-inch model, smaller than the then standard model, was equally efficient within the limits of experimental error.

Figure 2 shows the results obtained by varying the diameter. (Purification is defined as the per cent improvement in specks per gram of the clean portion over the original.)

The length of the conical section of the separator was carefully investigated. Improvement was continuous, even up to a cone length of 46 inches on the $3^1/_{16}$-inch diameter head. Beyond a length of about 32 inches, however, the improvement was so small it did not justify the additional cost of manufacture. Figure 3 shows the relationship of cone length to purification and cost per unit improvement.

Figure 4 shows the effect of consistency. The results for 1.036 and for 1.020 sp. gr. dirt are given to show how the optimum conditions are displaced, depending on the type of dirt it is intended to remove. This effect was also noted on several of the dimension variables. Because the removal of "light" impurities such as pitch, small bark, and wood dirt was intended, the optimum for the lower specific gravity dirt was

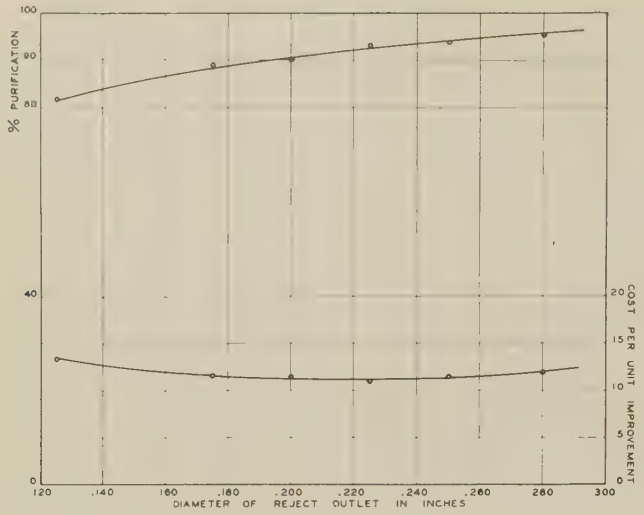

Fig. 5

followed. Therefore, an imput consistency of about 0.5% is recommended. For the removal of effectively heavier particles, such as inorganic impurities, it is easily possible that a consistency close to 1% might be entirely adequate with only one half the pumping and installation cost.

The size of the reject outlet at the apex of the cone has a great influence on the percentage of fiber "tailed off." It is quite obvious that the higher the percentage tailed, the cleaner the accepted fraction will be. The value of 0.220 inch for this tip size gave the greatest efficiency for unbeaten sulphite pulp. It is interesting to note that for the shorter-fibered, well-beaten sulphite a much smaller tip (0.125 inch) is indicated. The difficulty of removing impurities seems closely related to fiber length. Recent work with unbeaten hardwood fiber indicates a reject outlet of a size intermediate between the optimum for unbeaten and that for beaten sulphite. To avoid recleaning an excessive amount of rejects the tip size should be kept as small as possible. The recommended tip outlet for unbeaten sulphite (0.220 inch) would give a reject fraction of 22 to 24% of the fiber with the recommended pressures, whereas for the shorter-fibered, beaten sulphite the rejects would be nearer 30% for these same conditions. However, using the recommended tip size for the latter pulp the fiber rejects would be approximately 7% for a single stage of cleaning. Figure 5 shows the results of a series of six tests varying outlet sizes with unbeaten sulphite pulp.

Figure 6 shows the results of variation in input pressure. Purification increases with an increase in pressure, but it is interesting to note that the efficiency or cost per unit of improvement curve is quite flat, indicating that "you get what you pay for." An input pressure of 35 to 38 p.s.i. does indicate a slight improvement of about 7% over the lowest and highest pressures (20 and 50 p.s.i.).

All of the variables were investigated in the above manner several times, because a change in the optimum for a variable made the others open to further search. The final results are the dimensions and conditions listed in Fig. 1. These results are optimum for unbleached spruce sulphite and the impurities usually associated with pulp of this character. Minor variations are indicated for other pulps.

MILL TRIAL

It was, of course, disappointing that experimental evidence indicated that the unit could not be enlarged without seriously sacrificing efficiency on the lighter types of wood dirt. Larger units would have simplified construction and maintenance and would probably reduce the necessary floor space. However, as pumping costs per ton of pulp would be equal for both a large and a small unit, and as these power costs amounted to nearly two thirds of the total cost, it was felt that the 3-inch diameter units should be retained in the design of the production units.

The first commercial unit was installed in the Hammermill sulphite mill in December, 1940. It was set up to clean the rescreened rejects of the fine screens. Previous to this time, this pulp had been kept segregated as a lower quality pulp not suitable for the grades manufactured. This pulp was extremely dirty, a considerable portion of the dirt being grit, pitch, and other small dark wood dirt.

The first stage of the system consisted of twenty of the 3-inch diameter units. Ten of these small units were mounted on each side of a 4-inch input header. A similar sized header, mounted over the input header, collected the accepted fraction. A trough under the outlets of the 20 cones collected the rejects which dropped to the tank and pump of the second stage. The first stage of 20 units occupied a floor space of only 2 by 6 feet.

The individual units used in this installation operating on unbeaten sulphite pulp rejected 12% of the liquid input and 24% of the fiber input. To recover the good fiber from this rejected fraction required a second stage of five separator units and a third stage

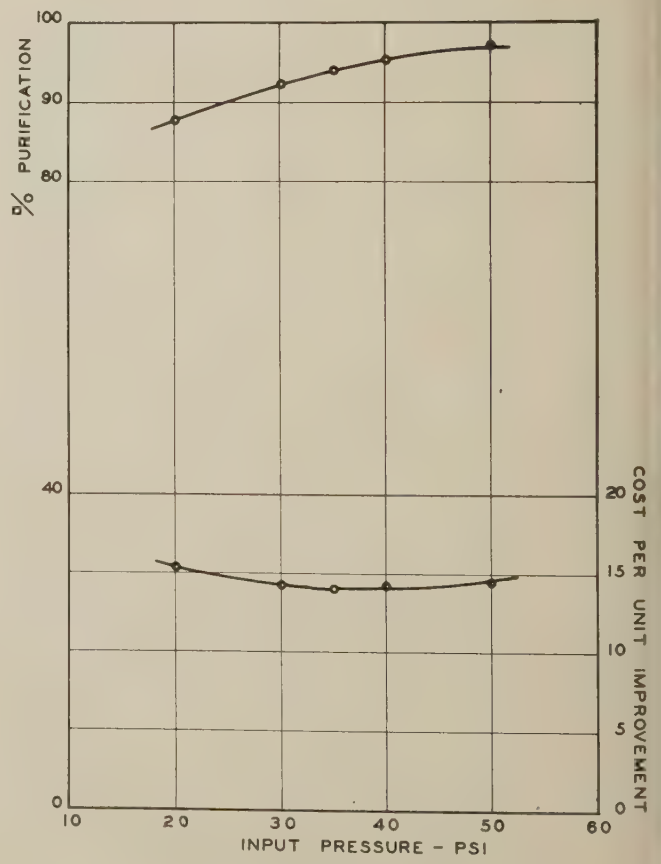

Fig. 6

of two units. These were installed on smaller but similar headers as described for the first stage. The installation was neat in appearance and handled 10 tons of pulp per day.

As the liquid rejects of a separator for spruce sulphite are 12% of the liquid input and the fiber rejects are 24% of the fiber input it is obvious that a thickening of the rejects occurs. For this reason it is necessary to dilute the stock between stages so that all stages are operating at the desired consistency. This dilution also provides a constant volume for the pump of the succeeding stage.

The final rejects from this system amounted to $2^1/_2$% of the input. It was not believed advisable to install an additional stage of recovery because of the extremely high dirt content of the third-stage rejects. Had the original pulp been cleaner, an additional stage of one 3-inch separator bringing the total rejects to near 1%, would have been justified.

It should be noted that, while the liquid rejects of each stage were the same, the fiber rejects increased from stage to stage. It seems that when one stage rejects a fiber fraction, the second and succeeding stages reject progressively more. Thus in this system the first stage rejected 24% of the input fiber, the second 29%, and the third 38%. The fiber remaining with the dirt in the final rejects is very slow and extremely short.

The cones for this system were first made of butt-brazed sheet Monel. Those wore out rapidly due to the very abrasive action of the grit on the small reject outlet. Monel being unobtainable during the war, replacement cones were made in the laboratory by the electrolytic deposition of copper on a polished mandrel. These cones were seamless and very streamlined and gave excellent results. As the copper wore at the tip, brass replacement tips were made and used successfully. These brass tips had a life of from 4 to 6 months.

At first excessive plugging of the reject outlets was encountered, occasionally as many as five plugs per day. Careful examination of the objects causing the plugs convinced us that nothing coming through screen plates would ever cause an outlet to plug. Covering of flumes to keep out foreign material and a better understanding of the necessary conditions on the part of the operators has reduced this to two or less plugs per week. These are easily handled without shutting down the system.

This first unit was planned for complete recirculation. That is, the accepted pulp from the second stage was added to the incoming stock and the accepted from the third stage went to the input of the second stage. Experience with the unit showed that the accepted from the second stage was as clean as the accepted from the first stage, so the two were combined. The third stage accepted was somewhat dirtier, so it is now added to the incoming pulp of the first stage and completely recycled.

The separator, working on dirt of varying specific gravities, does not remove long wood shives, although it has a good efficiency on short chunky ones. For this reason, the accepted stock from this separator system is circulated back to the fine screens. The advent of three-stage high-density bleaching with its resultant better bleaching or break-up of shives has made this less necessary, but it is still practiced. On the speck dirt for which the cleaner was designed, the results have been very satisfactory. Not only the larger objectionable particles but also considerable percentage of the fine dirt is removed. A thin wet handsheet viewed through transmitted light showed removal of 80 to 95% of the speck dirt visible to the unaided eye. Because the specks counted were so small, the dry handsheets under normal viewing conditions were substantially dirt free.

All of the production experience to date has been obtained with spruce sulphite pulps. On occasion, however, laboratory trials on hardwood pulps have been made. These pulps from the shorter fibered hardwoods are easier to clean than are the coniferous pulps. The degree of wood dirt removal is excellent even when unbarked wood has been cooked. The amount of rejects per stage is reduced because a small reject outlet can be recommended for these pulps and fewer stages are required to bring the final rejects to a reasonable figure.

COMMERCIAL DEVELOPMENT

Further applications of the Hammermill separator were halted because of material shortages during the war years. The fabrication of the cones also posed a problem. Sheet metal was adequate but mill usage might dent, or otherwise damage, the units which were rather expensive to fabricate.

The individual units, head, cone, and tips are now being molded of hard rubber. They are made in four sections, any one of which can be replaced if damaged. Molded construction will ensure the accuracy needed and the absence of projections and ridges on the interior surface. The tips will screw on and can be replaced easily and cheaply when wear occurs.

They are being marketed in standard units of 20 cones, 10 on each side of the necessary inlet and accepted stock headers. Units with less than 20 cones are available when necessary. Convenient reject collectors are provided. The cones are self supported and attached to the headers with rubber hose. Individual cones can be cleaned or removed without shutting down the system. The standard units themselves can be joined to form long rows. An installation now being prepared will provide capacity for 100 tons per day at 0.5% consistency, and a room 16 by 30 feet is adequate to accommodate such a unit equipped with all the tanks and pumps necessary for the three stages.

Most of the experience gained so far has been with spruce sulphite pulps. As previously stated, other pulps behave differently in the ease or difficulty with which dirt can be removed. Evidence gained so far indicates that only minor changes in the dimensions of the basic unit are necessary to adapt it to other types of fiber.

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Occurrence of Cellulases in Enzyme Preparations from Microorganisms

CURTIS S. WALSETH

A procedure has been developed for producing from cotton linters relatively large batches of high reactivity cellulose suitable as a substrate for enzyme studies. A representative group of commercial enzyme preparations has been evaluated for their cellulase activities. One was found with a relatively high activity and was selected for use in further studies. This was a preparation from *Aspergillus niger* produced by the Rohm and Haas Co. and designated by them as Enzyme 19AP. A study was made of some of the variables concerned with the enzymic hydrolysis of cellulose, and the results were compared with previous reports by Karrer and his co-workers based on the cellulase from the snail (*Helix pomatia*). Some of the results may be listed briefly as follows: (a) For Enzyme 19AP (emulsin A), a pH of 4.5 was shown to be optimal for a 16-hour reaction at 47°C. (b) For a 5-hour reaction, a doubling of enzyme quantity was shown to increase the extent of hydrolysis by only about 50%, for extents of hydrolysis up to about 40%. (c) The characteristic nature of the variation of the extent of hydrolysis with time was shown to be a rapid rate in the initial stage, followed by a decrease to a very low rate, usually with considerable cellulose still remaining undissolved. The ease of hydrolysis of different celluloses was shown to be extremely variable. The amount of reducing sugar formed (as glucose) was found to be equivalent to the amount of cellulose solubilized by the action of the enzyme. Since hydrolyses were not carried out under sterile conditions, a group of antiseptics were evaluated for suitability for use with Enzyme 19AP to prevent consumption by microorganisms of the sugar which accumulates as a reaction product. The antiseptics were phenylmercuric acetate, Dowicide D (trade name for the sodium salt of 2-chloro-4-phenylphenol), Roccal (trade name for a mixture of high molecular alkyldimethylbenzylammonium chlorides), thymol, and toluene. All except Dowicide D appeared to inhibit cellulase action to some extent. The inhibition by Roccal was the greatest, reducing the activity of the cellulase by about one half.

THE detection of cellulolytic enzymes in fungi (*1*, *2*) and in germinating seeds (*3*) was reported more than a half century ago and cellulases from these and other sources have been given attention by a number of investigators since that time, particularly by Karrer and his co-workers (*4*), who studied the enzyme from the digestive juice of the snail (*Helix pomatia*). However, the application of enzymes to cellulose has yet to attain a state of development where it possesses a high degree of scientific or technological usefulness. The status of the knowledge of cellulolytic enzymes has been discussed (*5–7*) in connection with recent reviews on biological decomposition of cellulose.

It was the purpose of this investigation to stimulate the interest of cellulose chemists in enzymic hydrolysis by reviewing commercial sources for a relatively active cellulase preparation, and by formulating simple procedures for its application. Previous investigators have used the more reactive regenerated or hydrate forms of cellulose as substrates almost entirely and the need for a simple method of preparing a cellulose more sensitive than native cellulose to enzymic attack was recognized in this investigation.

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EXPERIMENTAL

Source of Enzymes

A number of samples of representative enzyme preparations, donated by several industrial firms, are identified according to source in Table II, which contains also a comparison of their activity. The preparations are designated by the term *emulsin*,* with the meaning: a crude or partially purified mixture of enzymes.

Cellulose Substrates

The basic cellulose used in this work was Hercules purified cotton linters, termed *Cellulose A* which had been shredded in an Abbé mill. The swelling action of cold 85% phosphoric acid was used for the preparation of reactive celluloses.

The treatment was carried out in the following manner. Phosphoric acid (85%) at a temperature of about 2°C. was added to cellulose A in sufficient quantity (about 13 ml. per gram of air-dried cellulose) to thoroughly soak the cellulose, with the aid of manual stirring. The mixture was then stored in the refrigerator at 2°C. for the desired time of swelling, after which it was removed and the acid washed out as rapidly as possible with ice water to minimize degradation. This washing was carried out by repeated cycles of suspension and filtration. Removal of the acid was facilitated in the first two cycles by brief agitation of the suspensions in a Waring Blendor. After about four washes with ice-cold water, the cellulose was suspended in a 1% sodium carbonate solution for 6 hours or overnight. Washing was then continued with distilled water at room temperature and was considered complete when the pH of a suspension was the same as that of distilled water within 0.1 unit.

Two large batches of cellulose were prepared by the swelling treatment for use as standard substrates in this work.† These products were termed *Cellulose B* and *Cellulose C*, and resulted from swelling periods of 10 minutes and 2 hours, respectively.

* A term which Helferich (*8*) has applied to mixtures of glycoside-hydrolyzing enzymes from plant extracts, and which was further broadened by Pigman (*9*) of the usage of this paper.

† However, before cellulose B and cellulose C were available, certain similar preliminary products were used as substrates in studies of some of the reaction variables.

In the preparation of large batches, the swelling and initial stages of washing were carried out with small batches of 20 grams of cellulose each. A suitable number of the small batches were then blended for the final stages of washing. Degree of polymerization values of

Table I. Standard Conditions for the Enzymic Hydrolyses

Variable	*16-Hour test*	*5-Hour test*
Cellulose (oven-dry),[a] g.	0.28–0.30	0.58–0.60
Cellulose concentration, %[b]	1.00	3.00
Enzyme concentration, %[c]	0.60	1.00
pH (Walpole acetate buffer)	4.5	4.5
Total acetate molarity	0.133	0.160
Temperature, °C.	47	47
Time, hr.	16	5

[a] Oven-dry weight as determined by drying to constant weight in an oven at 110°C.
[b] Grams/100 ml. of solution.
[c] Grams of solids extracted from the emulsin/100 ml. of solution.

1385, 1310, and 1215, determined from the viscosity in acetone of the nitrate derivatives according to a method similar to that described by Atchison (*10*), were obtained for celluloses A, B, and C, respectively.

Procedures

Enzyme Stock Solutions. The dry emulsins were treated with cold water. Clear solutions were obtained by first centrifuging the suspension and then filtering the supernatant liquid through a Pyrex fritted-glass filter (F porosity). The solids content of the solution was determined by drying 1- or 2-ml. aliquots of the solution *in vacuo* over calcium chloride. A mat of glass wool in the bottom of the weighing bottle prevented loss from foaming upon evacuation. The content of solids, in grams per 100 ml., is referred to as "enzyme concentration," although materials other than cellulases are present. Stock solutions were stored under toluene in a refrigerator at about 2°C. It was determined experimentally that no loss in activity occurred on 2 weeks of storage under these conditions and that the activity decreased only very slowly thereafter.

Enzymic Hydrolyses. Air-dried cellulose was weighed into a screw-capped, glass, cylindrical container, usually a 4-dram vial. A buffered enzyme solution was made up to the desired composition and was added to the cellulose in sufficient quantity to give the desired cellulose "concentration," expressed as per cent [grams of cellulose (oven-dry basis) per 100 ml. of added solution]. The size of the container and the solution volume were so adjusted that very little empty space remained in the container. If necessary, Dowicide D (sodium salt of 2-chloro-4-phenylphenol) was added to the solution to give a 0.01% concentration to prevent consumption of the hydrolytic product by microorganisms. The antiseptic was required only if aliquots of solution were to be removed repeatedly from the test mixture. When the bottle remained sealed throughout a reaction, no antiseptic was necessary.

After addition of the solution, the bottle was sealed and rotated in a water bath maintained at a constant temperature. At the end of the desired reaction time, the bottles were removed from the bath and the contents were filtered immediately on tared Pyrex fritted-glass crucibles (M or C porosity). The cellulose was washed thoroughly with distilled water, dried at 105°C., and weighed. The extent of hydrolysis was calculated as the loss in weight of the original sample in per cent. The extent of hydrolysis was also frequently evaluated by the determination of reducing sugar in the filtrate, according to the method of Somogyi (*11*). Studies of the rate of hydrolysis were made either by determining the loss in weight of individual cellulose samples for each time interval, or by determinations of reducing sugar in aliquots of solution removed repeatedly from a single larger test mixture. The two methods gave closely similar results, but the former method was generally more convenient.

Conditions for the Enzymic Hydrolyses. Although the experimental procedures frequently varied all experiments were based on one of two sets of conditions with only slight variations. These two sets of conditions were termed the *16-hour test* and the *5-hour test* and are listed in Table I. In addition to the general use of these conditions in studies of the influence of certain variables, the 16-hour test was used particularly as an index of reactivity of various celluloses, whereas the 5-hour test was used, particularly with cellulose C, as an index of activity of the enzyme solutions.

Table II. Comparison of Cellulase Activities of Various Commercial Enzyme Preparations[a]

Emulsion	*Source*	*Manufacturer*	*Results at pH 4.5*			*Results at pH 6.5*		
			Enzyme concn., %	*Loss in weight, %*	*Relativity activity*	*Enzyme concn., %*	*Loss in weight, %*	*Relative activity*
A[b]	*Aspergillus niger*	Rohm and Haas	(See Fig. 1)		100	..	..	..
B	*Aspergillus niger*	Rohm and Haas	1.99	33.2	62.8	1.99	14.6	16.1
C	*Aspergillus niger*	Rohm and Haas	3.05	44.2	71.2	2.84	15.9	13.1
D	Pancreas	Jacques Wolf	3.10	..	..	3.10	..	..
E	*Aspergillus oryzae*	Jacques Wolf	1.97	1.4	1.0	1.97	0.7	0.5
F	*Aspergillus japonicus*	Jacques Wolf	1.16	3.3	2.6	1.16	1.1	1.3
G	*Aspergillus flavus*	Schwarz Labs.	1.97	8.2	6.9	1.97	2.7	1.5
H	*Aspergillus oryzae*	Takamine	1.96	3.4	2.0	1.96	1.8	1.3
I	*Aspergillus oryzae*	Takamine	1.88	2.3	1.6	1.88	1.1	0.8
J	*Aspergillus flavus-oryzae*	Wallerstein	0.91	2.8	1.7	0.91	0.9	0.6
K	*Bacillus mesentericus*	Wallerstein	3.93	..	..	3.54	..	..

[a] Cellulose C for 5 hours at 47°C.
[b] Enzyme 19AP.

Evaluation of Cellulase Activities of Commercial Enzyme Preparations

The emulsins which were evaluated for their cellulase activities are listed in Table II by code letter, source,

and producer, together with the results of the activity comparison. On the basis of the results of Table II, emulsin A (produced by Rohm and Haas Co. and designated by them as Enzyme 19AP) was used exclusively as the source of cellulase for the remainder of the investigation.

The method adopted for the evaluation of relative cellulase activity was to determine the percentage loss in weight of a sample of cellulose C under the 5-hour test conditions, using any reasonable concentration (C_x) of the emulsin under consideration. Then the concentration of emulsin A (C_a) which would produce the same loss in weight was read from a curve of loss in weight versus enzyme concentration for emulsin A (Fig. 1). The activity of the emulsin which was being evaluated was then calculated by the formula

$$\text{Relative activity} = C_a/C_x \times 100$$

Thus, an activity scale was derived upon which emulsin A had a value of 100.

For each emulsin, a test was made at pH 4.5, using acetate buffer, and at pH 6.5, using phosphate buffer. It was considered that any significant activity would be detected at one of these two pH values.

Correlation of Values of Extent of Hydrolysis Obtained by Loss in Weight and by Reducing Sugar Determinations

The extent to which the loss in weight obtained in enzymic hydrolysis is reflected in reducing sugar (calculated as anhydroglucose units) is of basic significance. Therefore,the results of a number of reactions, in which both methods were applied, are presented in Fig. 2. A straight line is drawn at a 45° angle, representing the locus of exact check values. The results were obtained with different celluloses and different reaction conditions.

Effect of Antiseptics

Five representative antiseptics were tested for their ability to prevent microbiological growth in enzyme hydrolyzates and for their effect upon the cellulase activity. Six cellulose-enzyme test mixtures were prepared, identical in all respects except that five contained antiseptics, and as a control, one contained none. The materials which were tested are listed in Table III with the concentrations at which they were applied. Sterility tests of the hydrolyzates at the end of the reaction period were made, and the effects of the antiseptics at the indicated concentrations are listed. The extents of hydrolysis ultimately attained as determined from the weight of the residues recovered at the end of the reaction are also listed in Table III. The variation of the reducing sugar content of the hydrolyzates during the course of the reactions are shown in Fig. 3.

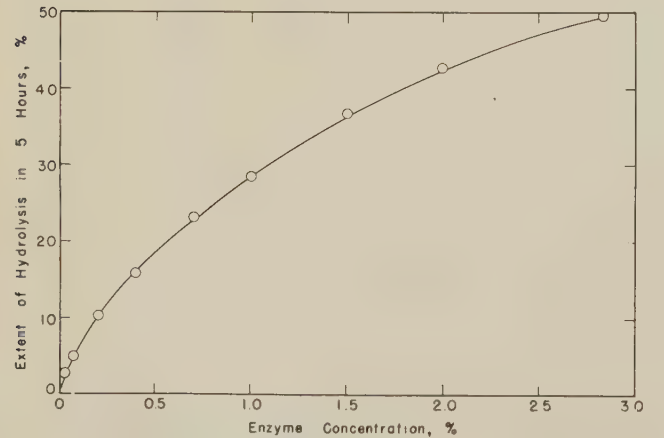

Fig. 1. Variation of extent of hydrolysis of cellulose C by emulsin A with enzyme concentration under the conditions of the 5-hour test

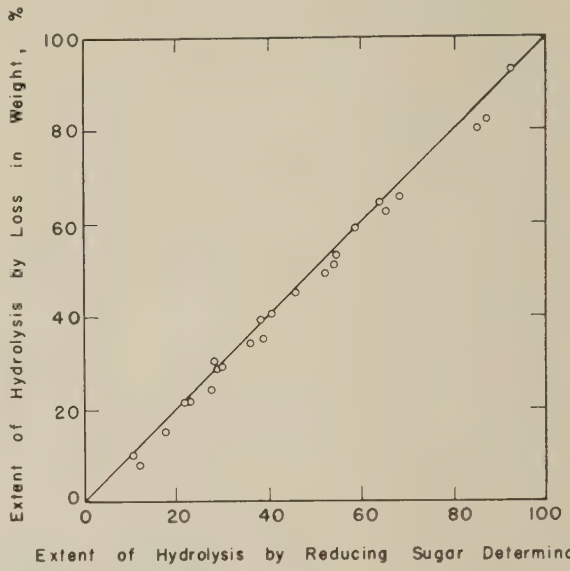

Fig. 2. Correlation of values of extent of hydrolysis obtained concurrently by loss in weight and by reducing sugar determination, with sugar calculated as anhydroglucose

Table III. Evaluation of Antiseptics for Use with Solutions of Emulsin A

Antiseptic	*Concn., %*	*Effect on microorganisms*	*Extent of hydrolysis,[a] %*
Blank	.....	.....	51.0
Phenylmercuric acetate	0.005	Killing	49.2
Dowicide D[b]	0.01	Inhibitory	51.0
Roccal[c]	0.05	Killing	29.5
Thymol	Saturation plus excess	Killing	46.9
Toluene	Layer on surface	Inhibitory	49.2

[a] Value ultimately attained, by loss in weight (see Fig. 3).
[b] Trade name for the sodium salt of 2-chloro-4-phenylphenol.
[c] Trade name for a mixture of high molecular alkyldimethylbenzylammonium chlorides.

The cellulose used in this study was a product similar to cellulose B. The enzyme used was from emulsin A. The reaction conditions were:

Cellulose (oven-dry), %	2.400
Cellulose concentration, %	2.00
Enzyme concentration, %	0.50
pH (by acetate buffer)	4.5
Total acetate molarity	0.09
Temperature, °C	47

From the results shown in Fig. 3, it appears that all antiseptics were effective in preventing loss of sugar by secondary fermentation. The values of the loss in weight in Table III show, however, that all antiseptics

(except Dowicide D) inhibited the action of the cellulases to some extent. Since neither the concentrations of the antiseptics nor their effect on the organisms

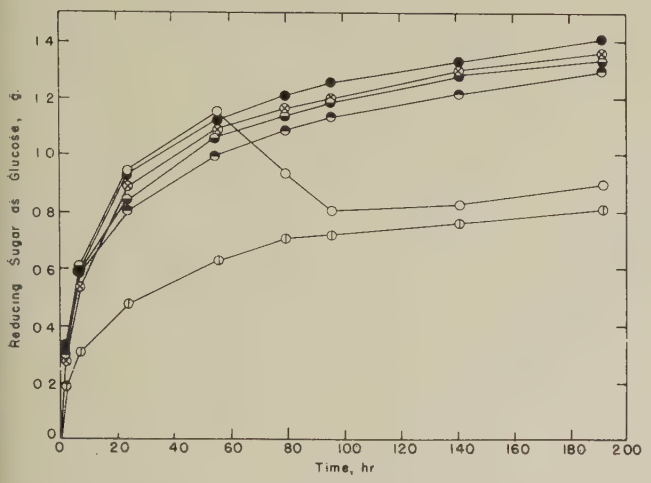

Fig. 3. Variation in reducing sugar content with time in identical reaction mixtures containing different antiseptics

were optimal, there is no fair basis for a comparison of their relative effects on the action of the cellulases. However, the data were adequate to justify the selection

Table IV. Effect of Cellulose Concentration on Extent of Hydrolysis with Constant Enzyme Concentration[a]

Cellulose concn., %	*Enzyme concn., %*	*Ratio of enzyme to cellulose, %*	*Extent of hydrolysis, %*
0.66	0.60	91.0	69.2
0.95	0.60	63.2	65.1
1.38	0.60	43.5	59.6

[a] Emulsin A and a cellulose product similar to cellulose C were used. Reaction conditions were those of the 16-hour test, except for the variation in cellulose concentration.

of Dowicide D for use when necessary in enzyme hydrolyses.

Effect of Variables on the Reactivity of Emulsin A

The major reaction variables (except temperature) were studied sufficiently to establish comparisons with results previously reported for cellulases from other

Table V. Effect of Cellulose Concentration on Extent of Hydrolysis with Constant Ratio of Enzyme to Cellulose[a]

Cellulose concn., %	*Enzyme concn., %*	*Ratio of enzyme to cellulose, %*	*Extent of hydrolysis, %*
0.24	0.076	31.5	17.7
0.96	0.302	31.5	21.3
1.91	0.602	31.5	24.8

[a] Emulsin A and a cellulose product similar to cellulose B were used. A temperature of 47°C., a pH of 4.5, and a reaction time of 17.5 hours were constant conditions.

sources. The temperature was maintained constant at 47°C. throughout this investigation.

Cellulose and Enzyme Concentrations. Table IV shows the effect of variation of cellulose concentration upon the extent of hydrolysis when the enzyme concentration was held constant. The effect of variation of cellulose concentration when the ratio of the amounts of enzyme and cellulose, rather than enzyme concentration, was held constant is shown in Table V.

The effect of enzyme concentration upon the extent of hydrolysis is shown by the curve of Fig. 1, which was obtained by the use of cellulose C and emulsin A. Reaction conditions were those of the 5-hour test, except for the variation in enzyme concentration.

Hydrogen Ion Concentration. The optimum pH for a 16-hour reaction at 47°C. was determined for emulsin A by the series of tests reported in Table VI. A pH of 4.5 is shown to be optimal by the results, and this value checks closely with values previously reported for cellulases of fungal origin (*12*, *13*).

Table VI. Effect of pH on Cellulase Activity of Emulsin A[a]

Buffer type	*Buffer pH*	*Extent of hydrolysis, %*
Acetate	2.8[b]	20.6
Acetate	3.7	27.1
Acetate	4.5	30.1
Acetate	5.2	27.4
Phosphate	6.0	21.1
Phosphate	7.0	5.7
Phosphate	8.0	4.4

[a] A cellulose product similar to cellulose B was used and the conditions of the 16-hour test were followed, except for the variation in pH and the use of the phosphate buffer in the higher pH range.
[b] By acetic acid alone.

Acetate Buffer Concentration. Six samples of cellulose C were treated with solutions of emulsin A under the 5-hour test conditions, with the exception that the acetate concentration was varied from 0.072 to 0.500 *M*.

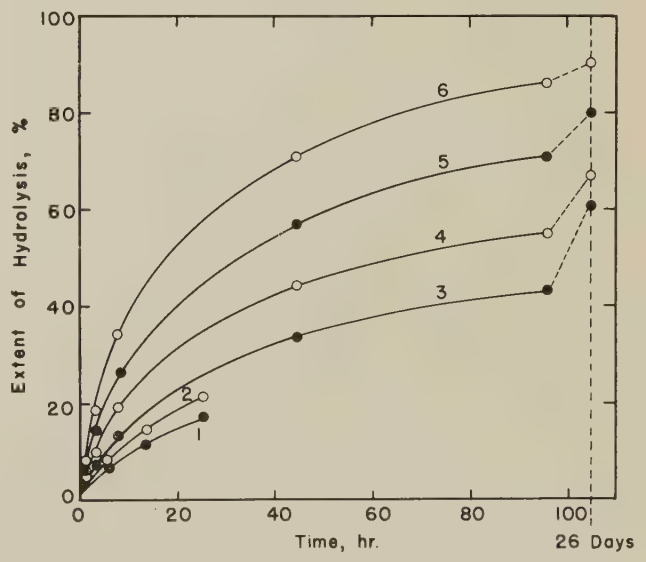

Fig. 4. Rate of hydrolysis of cellulose C by emulsin A under various conditions of cellulose and enzyme concentrations

This increase in acetate concentration resulted in a progressive decrease in extent of hydrolysis from 29.2 to 26.8%

Time. The rate of hydrolysis of cellulose C under

various conditions of cellulose and enzyme concentrations is shown by the family of curves in Fig. 4.

Emulsin A was used and all reactions were carried out at a temperature of 47 °C. and a pH of 4.5 with acetate buffers. The curves, which are extended to 26 days, were derived by the determination of reducing sugar in aliquots of a single test mixture. Those which extend only to 25 hours are based on values of loss in weight of individual samples for each time interval.

Figure 5 shows the variation of extent of hydrolysis with time for cellulose A, cellulose B, and cellulose C for a constant set of reaction conditions.

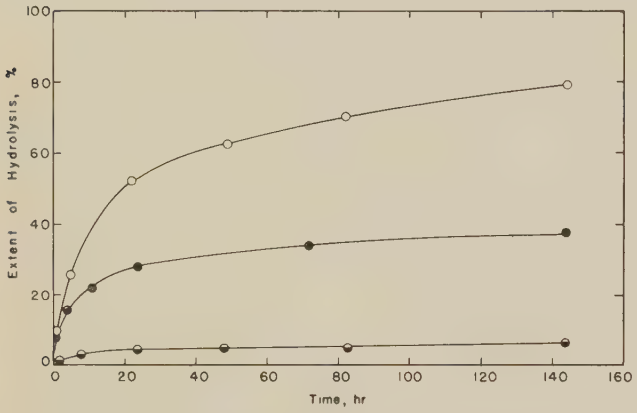

Fig. 5. Rate of hydrolysis of various celluloses by emulsin A under the conditions of the 5-hour test

Emulsin A was used and the reaction conditions were those of the 5-hour test, except for the variation in time and the fact that larger sample sizes were used in order that certan determinations might be made on the recovered residues, which will be reported in another paper. Loss in weight was determined on individual samples for each time interval.

DISCUSSION

The results given in Table II show that all the fungal emulsins which were evaluated showed some detectable cellulase activity. The fungi from which these emulsins were derived were all of the *Aspergillus* genus. No activity was shown by the pancreatic or the bacterial emulsins. A pH of 4.5 was shown to be more nearly the optimum than pH 6.5 for all the fungal emulsins: consequently, the values at pH 4.5 are considered to be the significant ones for comparison. The emulsins of *A. niger* showed the highest activity. (Emulsin A which showed the highest activity was designated by the producer as Enzyme 19AP and is the product used elsewhere in this work.) The activities of the *A. niger* emulsins exceeded those of *A. oryzae*, *A. japonicus*, and *A. flavus* by amounts ranging from 10 to 100-fold.

The hydrolytic action of emulsin A is indicated by Fig. 2, which shows that, within experimental limits, the loss in weight of cellulose resulting from the enzymic treatment is quantitatively accounted for by the presence of reducing sugar (calculated as anhydroglucose). There is a slight trend for the reducing sugar values to give high results.

This result might also be considered an indication that the enzyme attacks the cellulose chain molecule in an endwise fashion with the production of glucose only. However, it cannot be considered as proof that longer water-soluble chain fragments (such as cellobiose, cellotriose, etc.) are not formed as intermediates. The reaction of the enzyme on the cellulose was terminatd by the rapid filtration and washing of the cellulose, but the enzyme in the filtrate was not inactivated and, thus, was capable of completing the hydrolysis of any longer chain fragments to glucose during the period of about an hour, which generally elapsed before the sugar determination was performed.

With respect to reaction variables, Table V confirms the statement of Karrer (*4*) that, to obtain maximum hydrolysis of cellulose, solutions of the highest possible concentration are required. A refinement of this observation may be made on the basis of Table IV, however. For a solution of a given enzyme concentration, the dissolution of a high total *fracion* of a cellulose sample is promoted by a low ratio of cellulose to volume of solution. On the other hand, the highest total *amount* of cellulose (proportional to the product of extent of hydrolysis by cellulose concentration) dissolved in a given volume of enzyme solution is promoted by a high ratio of cellulose to solution.

According to Karrer (*4*), a doubling of enzyme quantity results in a 45 to 65% increase in the extent of hydrolysis. This statement is generally substantiated by the results given in Fig. 1 and Table VII.

Table VII. Extent of Increase in Hydrolysis Obtained by Doubling Enzyme Concentration

Enzyme concn., %	*Extent of hydrolysis,[a] %*	*Increase by doubling, %*
0.125	7.5	..
0.25	11.8	57
0.50	18.8	59
1.00	28.3	51
2.00	42.7	51
1.50	36.7	..
3.00	50.7	38

[a] Values read from curve of Fig. 1.

It has been reported by Karrer (*4*) that cellulose hydrolysis by the snail enzyme follows the monomolecular form for a time, then follows Schutz's rule.‡ The reaction rate data of this investigation, represented by Fig. 4, failed to adhere to either the monomolecular or the Schutz form.

However, it was found that, in the early stage of the reaction (up to about 24 hours), a plot of the extent of hydrolysis versus time on the log-log scale yielded a straight line. A set of reaction rate data in this range could consequently be fitted to an equation of the form

$$x = kt_n$$

where x is the extent of hydrolysis, t is the time, and k and n are constants. Equations of this form have frequently been used for esterification rates of cellulose (*14*). There is some indication that the constant k may bear a relation to enzyme activity under certain conditions, and thus might be made the basis of a rational method of expressing cellulase activity.

‡ That is, the extent of hydrolysis is proportional to the square root of the reaction time.

The characteristic nature of the hydrolysis rate curves of this investigation was a very rapid reaction in the initial stage, followed by a decrease to a low and virtually constant rate in the late stage (see Fig. 5), at which point considerable cellulose usually remained undissolved. The ease and extent of hydrolysis varied greatly with different celluloses. Reaction rate curves of this type and similar variations of the reactivity of different types of celluloses are commonly observed in other cellulose reactions; the phenomena have generally been interpreted on the basis of the two-phase structure of cellulose (*15*, *16*)—i.e., the existence of the cellulose chain molecules in both crystalline and amorphous states (*17*). An investigation of factors affecting the rate of enzymatic hydrolysis of cellulose, a study of the effect of enzymic hydrolysis upon the nature of the undissolved cellulose residues, and interpretations of the phenomena based on the knowledge of the fine structure of cellulose will be presented in a later paper.

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The Influence of the Fine Structure of Cellulose on the Action of Cellulases

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In the hydrolysis of cellulose with enzymes of *Aspergillus niger* at 47°C., it was shown that a great decrease in the rate occurred in the late stage of the reaction, usually with considerable cellulose still remaining undissolved. The most important factor contributing to this lowered rate was shown to be a decrease in the reactivity of the residual cellulose during the course of the reaction, but the activity of the enzyme solution itself decreased somewhat during the course of the reaction. Inactivation of the enzyme by heat and inhibition by the presence of glucose were both shown to contribute to the loss in activity, with the former being somewhat more important. As the enzymic hydrolyses progressed the moisture regain values for the undissolved residues decreased. This is evidence that amorphous regions were attacked most rapidly and that this preferential removal of amorphous cellulose was the reason for the decrease in reactivity of cellulose noted during the course of the enzymic hydrolysis. The relative content of amorphous cellulose, as indicated by moisture regain values, was shown to be the main factor which could account for the great differences that were observed in the ease and extent of decomposition of various celluloses by enzymes. A striking difference between the nature of acid and enzymic hydrolysis of cellulose was detected. By means of enzymic treatment, it was found possible to dissolve a considerable portion of a cellulose sample, but still to retain a relatively high degree of polymerization in the residual cellulose, whereas an acid hydrolysis, which results in any appreciable loss in weight, decreases the degree of polymerization of undissolved cellulose to a very low level. The most likely explanation for the difference lies in the relative size of the two hydrolytic agents and their consequent ability to penetrate the cellulose fine structure.

In a previous paper (*1*), it was shown that the enzymic hydrolysis of cellulose is characterized by a very rapid reaction rate in the initial stage, followed by a decrease to a low and virtually constant rate in the later stage, usually with considerable cellulose still remaining undissolved. The difficulty of attainment of complete enzymic hydrolysis of cellulose has previously been reported by Karrer (*2*), who also pointed out the extreme variability of different celluloses with respect to ease of hydrolysis, from native cellulose (which is extremely resistant) to some of the more reactive regenerated celluloses. In the present work the causes of these phenomena are considered. In addition, the effect of enzymic action upon the undissolved cellulose residues from the hydrolysis reactions, as reflected by measurments of the degree of polymerization and the moisture regain, was considered, since no direct evidence was available concerning this effect. This information should be of assistance in interpreting the kinetics and general nature of the enzymic hydrolysis of cellulose.

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EXPERIMENTAL

Materials and Methods

Enzyme Source. The source of cellulase used in this investigation was a commerically available, unpurified preparation from *Aspergillus niger*, which was reported previously as Emulsin A (*1*). It is produced by the Rohm and Haas Co. and designated by them as Enzyme 19AP. The dry emulsin was extracted with cold water, and clear solutions were obtained by centrifuging and then filtering the supernatant solution through a Pyrex fritted-glass filter (F porosity). The solids content of the filtered solution was determined by drying 1- or 2-ml. aliquots of the solution *in vacuo* over calcium chloride. A mat of glass wool in the bottom of the weighing bottle prevented loss from foaming upon evacuation. The solids content in grams per 100 ml. is referred to as "enzyme" concentration, although considerable materials other than cellulases undoubtedly were present.

Cellulose Substrates. Three celluloses having reactivities distributed over a wide range were used as substrates in this investigation. One was shredded Hercules purified cotton linters, designated as *Cellulose A*, which exhibited a relatively high resistance to enzymic attack. The other two celluloses were products of the swelling of cellulose A in cold 85% phosphoric acid. A product of a 10-minute swelling period was designated as *Cellulose B*, and that of a 2-hour period as *Cellulose C*. The details of the preparation of celluloses B and C were described in the previous paper (*1*). Cellulose C had the highest reactivity and that of cellulose B was intermediate cellulose A and cellulose C.

Enzymic Hydrolyses. Hydrolysis reactions were carried out in general, according to the procedure which was described previously (*1*), with the exception that the extent of hydrolysis was evaluated exclusively by gravimetric determinations of the amount of undissolved cellulose. The previously reported "5-hour test" conditions were used as the standard conditions of this investigation, except for any variation required by the purpose of a particular experiment, which will be indicated. The standard conditions are listed below:

Cellulose (oven-dry), g.	0.58–0.60
Cellulose concentration, %[a]	3.00
Enzyme concentration, %[b]	1.00
pH (acetate buffer)	4.5
Total acetate molarity	0.16
Temperature, °C.	47

[a] Grams per 100 ml. of solution.
[b] Grams of solids extracted from the emulsin per 100 ml. of solution.

Moisture Regain. The property of cellulose referred to subsequently as *moisture regain* is the equilibrium moisture content of the cellulose, approached from the dry side, attained at 50% relative humidiy and 73°F.

The procedure was as follows: After the cellulose residue from an enzymic treatment had been filtered on a Pyrex fritted-glass crucible and completely washed with water, it was washed with acetone to remove the water. The cellulose residue was then dried over sulphuric acid at 1 to 2 mm. for at least 24 hours. The crucibles containing the cellulose were exposed to the controlled atmosphere until the cellulose had attained constant weight. The cellulose was then dried in a vacuum oven at 50°C. and reweighed. The equilibrium moisture content of the conditioned cellulose was calculated as the percentage of the air-dry weight.

Degree of Polymerization. The determinations of the degree of polymerization were carried out according to a method similar to that described by Atchison (*3*). According to this method, the cellulose is converted into cellulose nitrate and the nitrate is dissolved in acetone. The intrinsic viscosity of this solution is determined and the degree of polymerization calculated according to the Staudinger equation (*4*), using for K_m the value of 11×10^{-4}. Celluloses which were to be evaluated for the degree of polymerization were not dried at a temperature higher than 50°C.

Effect of Various Factors on the Reaction Kinetics

In the studies of the rate of hydrolysis, a marked decrease in the rate was observed in the later stages of the reaction. It was desired to evaluate the relative effects of certain factors which were considered to be possible causes for the decreased rate. These factors were (1) a decrease in the average reactivity of the cellulose resulting from the removal of its more accessible portions, (2) inactivation of the enzyme by heat, and (3) inhibition of the enzyme action by the accumulated reaction products (glucose). The effects of these factors were isolated according to the procedure described below and the results are reported in Fig. 1.

A 50.25-gram (oven-dry basis) sample of cellulose B was subjected to hydrolysis by a 1% enzyme solution at 3% cellulose concentration for 72 hours. The residual cellulose (Cellulose B-72) and the hydrolyzate (hydrolyzate A) were then separated, and hydrolyzate A was tested for activity immediately by a rate of hydrolysis determination on fresh samples of cellulose B. Simultaneously, rate determinations were made using two "synthetic" compositions simulating hydrolyzate A. Both were identical in enzyme concentration and pH; one had been subjected to a reaction temperature of 47°C. along with hydrolyzate A, but contained no D-glucose, whereas the other contained D-glucose equivalent to the cellulose which had dissolved in hydrolyzate A, but had not been subjected to the heating period. All rates were compared with that of a fresh enzyme solution on samples of cellulose B, under the standardized conditions. The various hydrolysis rate curves for a period of 24 hours are plotted in Fig. 1.

Cellulose B-72 was washed thoroughly with water, acetone, and ether. It was then air dried at room temperature. The yield was 32.35 grams (oven-dry basis), a loss in weight from the original sample of 35.6%. The rate of hydrolysis of cellulose B-72, using fresh enzyme solution, was then determined at both 3.0 and 1.9% cellulose concentration, the latter being the concentration which existed when cellulose B-72 and hydrolyzate A were separate. The results at 3.0% concentration are plotted in Fig. 1. However, in order that it may be shown in its proper relation, the data for 1.9% concentration are superimposed as a dotted curve on the curve for cellulose B of Fig. 2. In order to determine the capability of cellulose B-72 for reactivation, a 5-gram portion was reactivated by the phosphoric acid treatment according to the original condi-

tions of the preparation of cellulose B. This reactivated product was termed cellulose B-72R. The rate of hydrolysis was then determined for this cellulose with fresh enzyme solution under the standardized conditions. Moisture regain values of 5.45 and 8.06% were obtained for cellulose B-72 and cellulose B-72R, respectively.

Effect of Enzymic Action on Undissolved Cellulose

The moisture regain and the degree of polymerization were determined on cellulose residues from hydrolysis rate determinations on celluloses A, B, and C, according to the following plan.

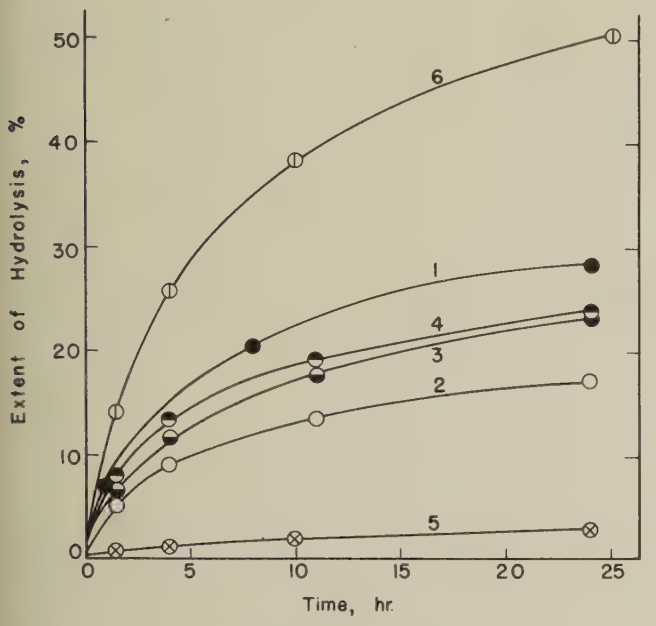

Fig. 1. Effects of various factors on the kinetics of enzymatic hydrolysis

(1) Cellulose B and fresh enzyme solution (control); (2) cellulose B and hydrolyzate A; (3) cellulose B and "synthetic" hydrolyzate A (heated); (4) cellulose B and "synthetic" hydrolyzate A (glucose added); (5) cellulose B-72 and fresh enzyme solution; (6) reactivated cellulose B-72R and fresh enzyme solution.

The rate of hydrolysis determinations was carried out under the standard conditions which have been listed, except that sufficiently large cellulose samples were used to allow the determination of the moisture regain, the degree of polymerization, and the loss in weight of the residues. In addition, the effect at the reaction temperature of 47°C. of water alone and of buffer solution alone (0.16 *N* total acetate, pH 4.5) on the degree of polymerization was determined for each of the celluloses.

A comparison was also made, for each cellulose, of the degree of polymerization resulting from enzymic and acid treatments which had produced comparable losses in weight.

Information was available (*5*) in the case of cellulose A for the selection of acid hydrolysis conditions which would approximately duplicate the 6.68% loss in weight which that cellulose had sustained by the maximum enzymic treatment of 144 hours. This treatment, applied to all three celluloses, involved heating at 100°C. with 0.25 *N* sulphuric acid (at 1% cellulose concentration) for 48 hours. The loss in weight and the degree of polymerization were then determined by the usual methods.

The results of this study are presented for cellulose A in Table I, for cellulose B in Table II, and for cellulose C in Table III. The curves of extent of hydrolysis as a function of time are presented in Fig. 2 for the three celluloses.

DISCUSSION

The rates of hydrolysis of three cellulose materials (A, B, and C) under similar conditions by an enzyme preparation from *Aspergillus niger* are shown in Fig. 2. Cellulose A is purified cotton linters, and celluloses B and C are samples of A swollen with phosphoric acid. Detailed data are given in Tables I, II, and III. Although the hydrolyses are similar in that they consist of a rapid phase followed by a slow phase, the rates and extent of the rapid phase differ markedly for the several celluloses. The decrease in rate in the second phase cannot be ascribed entirely to an inactivation of the enzyme, for, as shown by the dotted curve, the rate of attack of the residual cellulose is only slightly increased when the residual material is separated and resuspended in fresh enzyme solution.

The cause of the slowing down of the rate of hydrolysis was investigated by a series of experiments with cellulose B and illustrated in Fig. 1. The typical curve for cellulose B and fresh enzyme is shown in curve 1.

The residual material when retreated with fresh enzyme solution is only slowly hydrolyzed (curve 5), but when it is reactivated by a swelling teatment with phosphoric acid, it becomes quite reactive again (curve 6).

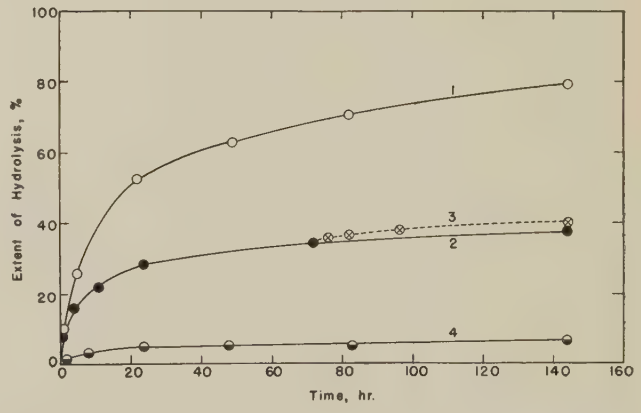

Fig. 2. Rate of enzymatic hydrolysis of various celluloses

The enzyme solution removed from the cellulose at the period of slow hydrolysis is still quite active when added to a fresh sample of the original cellulose (curve 2) but not quite as active as originally (curve 1). The decrease in activity seems to result from a partial inactivation of the enzyme, because when a portion of the enzyme solution is kept for 72 hours at 47°C. before addition to the cellulose sample (curve 3), the rate of hydrolysis is less than with the fresh enzyme solution. However, the hydrolysis products also

exert an inhibiting influence, since the rate is slower in the presence of added D-glucose (curve 4).

These results indicate that the principal reason for the slowing down of the hydrolytic reaction is the removal of easily accessible portions and the accumulation of difficultly accessible (presumably crystalline) portions. However, inhibition by glucose formed in the hydrolytic reaction and inactivation of the enzyme exert significant but minor influences. It does not appear that the minor differences in the degree of polymerization of these materials (1385 to 1215; see Tables I, II, and III) can be enough to account for the great differences in the rates of enzymic hydrolysis. External surface area or particle size would also seem to be excluded as the principal cause of variation in reactivity, since the three products were subjected to the same mechanical treatments.

Reaction rate curves similar to those given in Figs. 1 and 2 are commonly observed for cellulose reactions. They have been interpreted as arising from the presence of amorphous (reactive) and crystalline (inactive) regions and have been used in the "chemical" methods of estimation of the amounts of these materials. Thus,

Table I. Effect of Enzyme Action on Cellulose A

Nature of treatment	*Reaction time, hr.*	*Cellulose solubilized (by loss in weight), %*	*Degree of polymerization of residue*	*Moisture regain value of residue, %*
Untreated	...	...	1385	...
Water blank[a]	24	...	1140	5.58
Buffer blank	1	...	1320	...
Buffer blank	24	...	1225	...
Enzyme	1/2	1.32	1135	5.19
Enzyme	2	1.69	1195	5.01
Enzyme	8	3.17	1245	5.01
Enzyme	24	4.81	1120	4.91
Enzyme	48	5.35	...	5.33
Enzyme	83	5.44	...	4.92
Enzyme	144	6.68	1105	5.35
Acid	48	6.34	105	...

[a] pH of suspension after 24 hours—7.2 (pH of distilled water—6.0).

Nickerson (*7*), using an acid hydrolysis method, obtained values of 6, 10, and 21% for the amorphorus fractions of purified cotton linters, wood pulp, and viscose rayon, respectively. The periodic acid oxidation method of Goldfinger, Mark, and Siggia (*8*) has likewise given a value of 6% for the amorphous fraction of cotton linters. Philipp, Nelson, and Ziifle (*9*) obtained, by the acid hydrolysis method, a value of 12% for the amorphous content of purified cotton linters, and values ranging from 17 to 31% for various rayons.

If the late portions of the curves in Fig. 2 are extrapolated back to zero time, the intercepts on the ordinate give values of approximately 5, 30, and 60% for the amorphous fraction of celluloses A, B, and C, respectively. The value for cellulose A (shredded cotton linters) is similar to that obtained in the chemical methods mentioned above.

The capacity of celluloses to take up water vapor is reflected in the amount of moisture absorbed under standardized conditions and is known as the moisture regain value. This value is also used as a measure of the amounts of amorphous and crystalline materials. Hermans (*6*), for example, has obtained values for the content of amorphous cellulose by the water-vapor sorption method which agree favorably with his results by density measurements and optical methods. By these physical methods, he obtained values of about 40% for the amorphous fraction of native cotton,

Table II. Effect of Enzyme Action on Cellulose B

Nature of treatment	*Reaction time, hr.*	*Cellulose solubilized (by loss in weight), %*	*Degree of polymerization of residue*	*Moisture regain value of residue, %*
Untreated	...	...	1310	...
Water blank[a]	24	...	1120	6.30
Buffer blank	1	...	1300	...
Buffer blank	48	...	1180	...
Buffer blank	120	...	1290	...
Enzyme	1/4	3.7	830	5.62
Enzyme	1	7.9	920	5.42
Enzyme	4	16.1	900	5.08
Enzyme	11	22.0	1020	5.02
Enzyme	24	28.2	900	4.99
Enzyme	72	34.2	1005	5.31
Enzyme	144	37.6	1080	5.43
Acid	48	8.3	80	...

[a] pH of suspension after 24 hours—6.2 (pH of distilled water—6.0).

50% for wood pulps, and about 75% for many different regenerated or hydrate celluloses.

In Tables I, II, and III, it is shown that celluloses A, B, and C had moisture regain values of 5.58, 6.30, and 9.37%, respectively, in order of increasing extent of swelling and of ease of hydrolysis. Also, it should be noted that, as the enzymic hydrolyses proceeded toward their maximum extent, the moisture regain values for the residues were all reduced to a common range of about 5.0 to 5.4%. It is shown in curve 5

Table III. Effect of Enzyme Action on Cellulose C

Nature of treatment	*Reaction time, hr.*	*Cellulose solubilized (by loss in weight), %*	*Degree of polymerization of residue*	*Moisture regain value of residue, %*
Untreated	...	...	1215	...
Water blank[a]	24	...	740	9.37
Buffer blank	1	...	850	...
Buffer blank	5	...	785	...
Buffer blank	16	...	820	...
Buffer blank	48	...	765	...
Enzyme	1/6	3.6	525	7.95
Enzyme	1/2	6.3	370	7.81
Enzyme	1	10.0	375	7.60
Enzyme	5	25.6	315	7.18
Enzyme	22	52.4	275	6.72
Enzyme	49	62.7	270	6.68
Enzyme	82	70.5	295	6.47
Enzyme	144	79.3	...	5.25
Acid	48	13.9	40	...

[a] pH of suspension after 24 hours—6.4 (pH of distilled water—6.0).

of Fig. 1 that the residue (cellulose B-72) which resulted from a partial enzymic hydrolysis of cellulose B was very resistant to further hydrolysis and had a moisture regain value of 5.45%. However, when this residue was subjected to the swelling action of cold 85% phosphoric acid, the resulting product (cellulose B-72R) was again easily hydrolyzed by the enzyme,

as shown by curve 6, and had a moisture regain value of 8.06%. Thus, the increase in ease of hydrolysis brought about by the swelling action appears to be directly related to the amorphous content of the cellulose.

As noted above, the "chemical" and "physical" methods give different results for the amounts of amorphous cellulose. This difference is difficult to explain. It would appear that any cellulosic surface which is accessible to water vapor in the water-vapor sorption method would likewise be accessible to the hydrogen (or hydronium) ion in an acid hydrolysis method, since the volume of a proton is practically negligible (*10*). Several possible explanations might be proposed for the low values of the amorphous content obtained by the chemical methods. Liquid water or reagent molecules may penetrate only partially certain portions of the amorphous regions which would be determined as amorphous by the water-vapor sorption method. An enzymic hydrolysis would probably represent an extreme case, because of the presumed large size of the catalyst molecules.

The possibility that recrystallization of amorphous cellulose may take place during the course of a reaction also may account for the lower results by chemical methods. Partial recrystallization of amorphous cellulose has been shown to take place upon heating in water under certain conditions (*11*). According to Brenner, Frilette, and Mark (*12*), the "chemical" methods may give erroneous results as a result of crystallization of chains liberated during hydrolysis. The data obtained in the present work for untreated cotton linters agree with those obtained with other "chemical" methods, although the conditions are quite different. If crystallization of chain ends occurred, the agreement of the results would be coincidental. In any case, it was shown in this work that crystallization of the unhydrolyzed material did not occur under these conditions, because swollen cotton linters kept for 16 hours at 47 °C. in the buffer mixture showed the same rate of attack by enzymes before and after the treatment.

The values for degree of polymerization in Tables I, II, and III show a striking difference between the effects of enzymic and acid hydrolysis upon the undissolved cellulose. For conditions of enzymic and acid hydrolysis which produced approximately equal losses in weight of cellulose A (Table I), the residue from the enzymic treatment retained a degree of polymerization of about 1100, whereas the acid residue had a value of only 105. With cellulose B (Table II), the difference becomes even more striking because, under the same conditions of hydrolysis, a 37.5% loss in weight resulted from the enzymic action, compared with only 8.3% for the acid treatment*; yet the residue from the enzymic action retained a degree of polymerization of about 1000, more than tenfold that of the residue from the acid hydrolysis. Thus, for cellulose A and cellulose B, the enzymic treatments resulted in degree of polymerization values which were only very slightly lower than those attained by water or buffer treatments alone.†

With cellulose C (Table III), the same general difference is still noted for the two types of treatments, but, in this case, the enzymically treated cellulose did not maintain a degree of polymerization as high as in the other two cases, but fell to slightly less than 300. This result might be expected in view of the extreme sensitivity of this cellulose, indicated by the fact that the water blank and buffer blank treatments alone reduced the degree of polymerization of this cellulose from 1215 to about 800.

The relative lack of effect of enzymic treatments on the degree of polymerization of cellulose residues concurrent with considerable loss in weight indicates that the cellulose in regions accessible to the large enzyme molecule may be rapidly and completely reduced to soluble products. When all readily accessible cellulose is dissolved, the hydrolysis, as evidenced by glucose production, still proceeds, but presumably takes place only on the surfaces of crystallites or inaccessible regions, with rapid and complete solution of each chain molecule as it becomes exposed in turn at the crystallite surface. In this manner, hydrolysis could proceed to glucose with only a fleeting existence in the system of any intermediate dextrins or short-chain fragments. In the case of acids, on the other hand, the active catalyst could penetrate the cellulose structure to a much greater extent and hydrolyze glucosidic bonds at points from which short fragments perhaps could not easily diffuse out of the cellulose structure.

It might be suggested that the rapid production of glucose without a great lowering in the degree of polymerization may indicate that the enzyme attacks the cellulose chains only at the ends, rather than at random over the entire length. No experiments were performed specifically to test this possibility, but the low value of 830 which resulted from the first 15 minutes of hydrolysis of cellulose B would indicate that a random attack took place immediately in the most accessible regions and that enough shortened chains were produced to have the effect of lowering the degree of polymerization significantly. Complete dissolution of these shortened chains could then take place quickly to leave only the longer chains in the inaccessible regions, and the degree of polymerization would rise again to the value of about 1000.

The observed differences between acids and enzymes should be of practical interest, for it means that the more reactive areas of cellulose may be removed by the action of enzymes without producing much chain degradation of the residual materials.

* That is, conditions which gave equal losses in weight of cellulose A samples did not give equal losses with the more reactive cellulose B.

† The water and buffer blank residues, rather than the untreated celluloses, are considered the legitimate bases for comparison of the degree of polymerization of the enzyme residues. It is difficult to explain the decreases in degree of polymerization which were produced by water and by buffer treatments. Since the pH measurements made on the water blanks after the heating period, all showed only slight increases from the value for distilled water, the degradation effect could not have been caused by acids retained in the cellulose.

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Length of Fibers in Certain Yucatan Hardwoods

MAXON Y. PILLOW

The average lengths of wood fibers determined in 13 Yucatan hardwoods varied from 0.69 to 1.67 mm. in the different species. This range is about the same as that of certain hardwoods used for pulp in the United States. Wood fibers of the Yucatan species consisted mostly of libriform fibers, but a few fiber tracheids were present in some species. Fiber tracheids are distinguished by small, bordered pits instead of the simple pits that are characteristic of libriform fibers. Septate fibers were found in only the species jujub. It is not practical to determine a unique average length of fibers for each of the Yucatan hardwoods. Reasonable estimates were made, however, for their classification by fiber length and for statistical evaluation of variability of fiber length, so that the range of average fiber lengths for each species can be predicted at a 95% level of probability.

In evaluation of pulp characteristics of certain Yucatan hardwoods at the Forest Products Laboratory, lengths of whole fibers present in sulphate pulps made from these woods were measured.* The relative length of wood fibers, that is, whether they are long or short as compared to fibers of other species, is important, because fiber length contributes to some strength properties of the ultimate pulp products. Large variations in length, however, are characteristic of each species. Bergman (*1*) therefore concluded that unique averages for species are not practical to determine because of the extremely large sampling that is required from many trees and from different parts of their trunks. Nevertheless, reasonable estimates of fiber lengths for a species can be made from small samples of pulp or wood and used for general classification and comparison of different species.

The fiber lengths of the Yucatan species were measured to determine their general classification, estimate their variability, and compare them with fiber lengths of North American species for which pulp characteristics are reasonably well known. In addition, the presence of other elements of the wood than the fibers was noted in the samples.

PROCEDURE

The species of wood were designated at the time of collection in Yucatan (Table I), but identifications made at the Forest Products Laboratory indicated some discrepancies with commonly accepted names. Therefore, herbarium material of each species was sent to the Chicago Museum of Natural History for examination before decisions were made on accepted nomenclature of the species.

Samples were available for determinations of the length of fibers in air-dried and unbleached sulphate pulps from 12 Yucatan hardwoods and in the wood from an additional species. Each of the pulps was thoroughly mixed, and a small sample of each was shaken in distilled water until the pulp separated and a uniform suspension was formed. Part of that suspension was stained with a 1% aqueous solution of gentian violet and the stained fibers were washed in several changes of distilled water. About one-half of the stained suspension was poured into a test tube and diluted with distilled water, so as to give a suspension of fibers suitable for microscopical examination and for measurement of whole fibers.

Lengths of whole fibers were determined for each pulp as distributed in a temporary mount on a microscopical slide and held to an approximately uniform thickness by a cover glass. By projecting images of the fibers on the slides at a magnification of 75.5 × whole fibers were identified and their lengths traced on paper. The traced lengths were measured to the nearest 1.0 mm. with a flexible scale.

The Yucatan wood, jujub, was not available in the form of pulp. Determinations of fiber lengths were therefore made by macerating microtome sections of the wood and measuring the separated fibers. The wood was macerated with a reagent of equal parts of 10% chromic acid and 10% nitric acid, and the separated fibers were suspended in water, stained, and measured by the same techniques as used for the pulps.

All measurements were restricted to whole elements that are technically classified as libriform fibers, fiber tracheids, or tracheids, and did not include such relatively short elements as vessel members and parenchyma cells, which occupy appreciable volumes of some hardwood species. One hundred measurements were made on each sample of pulp or macerated fibers of the 13 Yucatan hardwoods. This number of measurements is commonly used for estimating fiber lengths of samples of wood. In this work, it was adequate to yield averages within an error of less than 10%, at a 95% level of probability for random determinations of lengths of whole fibers.

CHARACTERISTICS OF FIBERS IN YUCATAN WOODS

Wood elements used to determine the fiber lengths

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* This work was done in cooperation with Maderera de Tropico, S. A., Cuernavaca 140, Mexico, D. F.

of the 13 species of Yucatan hardwoods were from typical secondary wood, or xylem tissue formed by cambium of the dicotyledonous group of plants. The wood consisted predominantly of fibrous elements with smaller amounts of vessel members and parenchyma cells. The fibrous elements were mostly libriform fibers, but those were frequently associated with lesser amounts of fiber tracheids. The fiber tracheids can be recognized by the relatively small border pits in their walls, as contrasted to the simple pits in libriform fibers. Both of these types of elements, which are broadly classified together as wood fibers, tended to have generally thick cell walls. Thicknesses of these walls varied by appreciable extents, however, so that some wood fibers with relatively thin walls were present in each sample. One species, jujub, contained mostly septate fibers, or libriform fibers in which septa or cross walls were formed after these fibers had attained their maximum length (Fig. 1).

Table I. Average, Range, Standard Deviation, and Coefficient of Variation of Fiber Lengths for Certain Yucatan Hardwoods and an Estimated Range of Average Fiber Lengths for Different Samples of Each Species

Name of species	Fiber length			Standard deviation of fiber length, mm.	Coefficient of variation of fiber length, %	Estimated range of average fiber lengths	
	Average, mm.	Minimum, mm.	Maximum, mm.			Lower limit, mm.	Upper limit, mm.
Kanchump (*Allophylus psilospermus* Radlk.)	0.69	0.331	0.967	0.147	21.3	0.66	0.72
Chaca (*Bursera simaruba* (L.) Sarg.)	0.89	0.437	1.417	0.170	19.0	0.86	0.93
Jujub (*Spondias mombin* L.)	0.92	0.450	1.510	0.209	22.7	0.88	0.96
Tatsi (*Pisonia aculeata* L.)	0.93	0.517	1.868	0.203	21.8	0.89	0.97
Ramon (*Brosimum alicastrum* Sw.)	0.98	0.636	1.444	0.162	16.6	0.94	1.00
Boo (*Coccoloba uvifera* (L.) Jacq.)	1.01	0.583	1.868	0.206	20.3	0.97	1.06
Kitanche (*Poincianella guameri* (Greenm.) Britt. and Rose)	1.09	0.662	1.642	0.161	14.8	1.05	1.12
Pixoy (*Guazuma tomentosa* H.B.K.)	1.18	0.556	1.735	0.283	23.9	1.13	1.24
Chanci (*Calyptranthes millspaughii* Urb.)	1.22	0.570	1.960	0.246	20.1	1.18	1.27
Zacahua (*Ficus lapathifolia* (Liebm.) Miq.)	1.24	0.662	1.934	0.308	24.8	1.18	1 30
Cochle (*Cecropia obtusifolia* Bertol.)	1.27	0.583	2.000	0.312	24.6	1.20	1.33
Ekulu (*Drypetes lateriflora* (Sw.) Kr. and Urb.)	1.52	0.874	2.821	0.338	22.2	1.45	1.59
Ceiba (*Ceiba pentandra* (L.) Gaertn.)	1.67	0.768	2.450	0.293	17.6	1.61	1.72

Fiber Lengths

Average fiber length varied from relatively short fibers, 0.69 mm., for kanchumup (Fig. 2) to much longer fibers, 1.67 mm., for ceiba. Table I lists the average fiber length that was determined for each species of the Yucatan hardwoods, in increasing order, and the minimum and maximum length observed in samples for each species. Figure 3 shows relatively long pulp fibers of ekulu.

Standard deviations of fiber lengths were calculated as a statistic of variability for each species. Variability in fiber length also was calculated as the coefficient of variation, which expresses variability as a per cent of the average (standard deviation/average × 100). Thus, the coefficient of variation, when used in conjunction with averages and standard deviations, is useful for comparing variability of fiber lengths among species. For example, both the average fiber length and the standard deviation of fiber length for ceiba are large, as compared with some other Yucatan hardwoods, but the coefficient of variation is relatively small, thereby indicating less variability in fiber length than in some of the other species (Table I).

Table II. Average, Standard Deviation, and Coefficient of Variation of Fiber Lengths for Certain United States Hardwoods and a Range of Average Fiber Lengths for Different Samples of Each Species[a]

Kind of wood	Number of samples	Average fiber length, mm.	Standard deviation of fiber length, mm.	Coefficient of variation of fiber length, %	Range of average fiber lengths	
					Minimum, mm.	Maximum, mm.
Sugar maple	4	0.74	0.154	20.3	0.71	0.78
Red maple	4	0.82	0.162	19.8	0.79	0.87
Quaking aspen	4	1.04	0.225	21.6	0.74	1.35
Basswood	3	1.13	0.186	16.5	0.97	1.30
Beech	4	1.18	0.285	24.2	1.07	1.42
Paper birch	3	1.35	0.296	21.9	1.25	1.41
Sweetgum	4	1.58	0.310	19.6	1.42	1.72
Southern magnolia	4	1.66	0.301	18.1	1.54	1.80
Black tupelo	4	1.82	0.475	26.1	1.58	2.01

[a] Original data from S. I. Bergman, *Tappi* 32, No. 11: 494 (Nov., 1949).

It is well known that averages of different samples drawn from an essentially normal population, such as average fiber lengths for samples of a given species of wood, are variable in the same manner as values for single samples. Thus, when reasonably good estimates of variability can be determined from random sampling, as for these Yucatan species, the ranges of average fiber lengths of different samples also can be estimated. Such estimates of upper and lower limits of average

fiber lengths appreciably extend the information that is available from measurements of these pulps. The two columns at the right of Table I show the lower and upper limits within which average fiber lengths can be expected to fall at a 95% level of probability for the 13 Yucatan hardwoods.

Comparison with North American Hardwoods

The fiber lengths of the Yucatan hardwoods con-

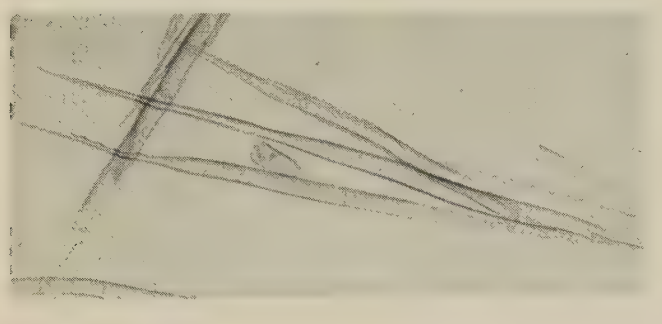

Fig. 1. Macerated wood fibers of jujub. Note septa or cross walls in the fibers. Highly magnified

formed reasonably well with those of several North American hardwoods, some of which are commonly used for pulp in the United States. Average fiber lengths have been reported for 49 United States species, for which determinations were made on two to four samples of wood, each from a different tree. From the published data of Bergman (*1*), average fiber length, standard deviation, and coefficient of

Fig. 2. Relatively short pulp fibers of kanchumup. Highly magnified

variation were calculated for each of 10 species (Table II) and compared with the data for the Yucatan hardwoods. The range of averages of fiber length for different samples of the 10 United States hardwoods indicates that considerable variability can be expected in any species. It is therefore evident that a unique average fiber length is not practical to determine for a species, but that a reasonable average may be obtained for general classification of a species with respect to either relatively long, short, or intermediate lengths of fibers.

Miscellaneous Elements of the Wood

Parenchyma cells and vessel members, which are characteristic of all hardwood species, were found in each of the samples of pulp or macerated fibers distributed over the microscopical slides. The parenchyma cells in each species were much shorter than the fibers, had relatively thin cell walls, and usually were rectangular in shape as seen under the microscope. The vessel members were generally shorter than whole fibers and tended to vary greatly in length, from about one quarter to as much as two thirds of the lengths of whole wood fibers in different species. Several short parenchyma cells, two connected vessel members with a large diameter, and parts of much longer and more slender libriform fibers from pulp of the wood ekuli are shown in Figure 4.

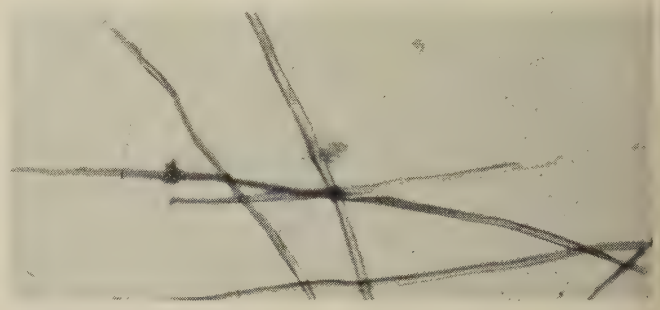

Fig. 3. Relatively long pulp fibers of ekulu. Highly magnified

The amounts of miscellaneous elements varied in the pulps or macerated fibers from the 13 Yucatan hardwoods, although wood fibers predominated in the suspensions examined microscopically. Parenchyma cells were most frequently observed in slides of ramon, boo, and ekulu, while the other species appeared to have

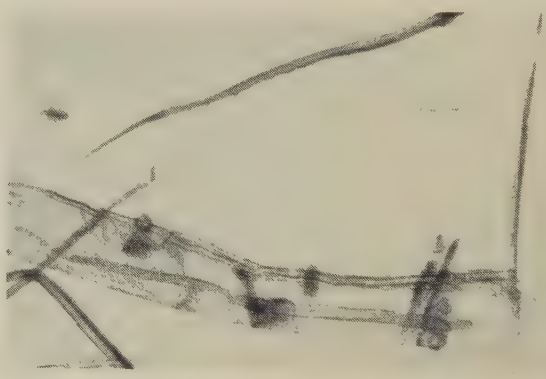

Fig. 4. Scattered short parenchyma cells, two connected vessel members, and parts of libriform fibers in pulp from ekulu. Highly magnified

moderate to small amounts of parenchyma cells in the pulp. About the same number of vessel members was observed in each of the pulps.

LITERATURE CITED

1. Bergman, Stuart I., *Tappi* 32, No. 11: 494–498 (Nov., 1949).

Received Feb. 8, 1952.

ASSOCIATION NEWS AND EVENTS

TAPPI 1953 Nominating Committee

The following principals and alternates have been appointed by the Executive Committee to serve as members of the TAPPI 1953 Nominating Committee to prepare a slate of candidates to be voted on by mail ballot prior to the 1953 Annual Meeting of the Association:

Principals:

Roderick O'Donoghue, Consulting Engineer, New York, N. Y.
A. E. H. Fair, Alliance Paper Mills, Merritton, Ont.
K. J. Mackenzie, Eastman Kodak Co., Rochester, N. Y.
J. J. Goss, Gaylord Container Corp., Bogalusa, La.
F. S. Klein, Byron Weston Co., Dalton, Mass.

Alternates:

C. A. Blodgett, Seaman & Seaman, New York, N. Y.
Andreas Christensen, Spruce Falls Power & Paper Co., Kapuskasing, Ont.
John D. Lyall, Armstrong Cork Co., Lancaster, Pa.
R. C. Richter, St. Marys Kraft Corp., St. Marys, Ga.
P. S. Bolton, Robert Gair Co., Uncasville, Conn.

The terms of the following officers and Executive Committeemen expire in February, 1953:

President: K. P. Geohegan, Howard Paper Mills, Inc., Dayton, Ohio
Vice-President: G. H. Pringle, Mead Corp., Chillicothe, Ohio
Executive Committeemen: K. O. Elderkin, Bowaters Southern Corp., Chattanooga, Tenn.; Milton Jacobs, Chas. T. Main, Inc., Boston, Mass.; R. W. Kumler, American Cyanamid Co., New York, N. Y.; G. E. Shipman, Donnacona Paper Co., Donnacona, Que.

Committee Secretaries

The following committee secretaries have been appointed recently:

Statistics Committee: Maynard S. Renner, Dewey & Almy Chemical Co., Cambridge, Mass., to succeed C. A. Bicking, Office of the Chief of Ordnance, Washington, D. C.
Microbiological Committee: G. A. Cruickshank, National Aluminate Corp., Chicago, Ill., has been appointed Secretary. Heretofore the committee has not had a Secretary.
Corrugated Containers Committee: Burt Mendlin, Cornell Paperboard Products, Inc., Milwaukee, Wis., to succeed Lewis K. Burnett, Ohio Boxboard Co., Rittman, Ohio.
Engineering Research and Machine Design Committee: R. D. Irwin, Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa., to succeed R. T. DePan, Downingtown Mfg. Co., Downingtown, Pa.

British Paper and Board Makers' Association

Frequently, members of TAPPI inquire as to how they may become members of the Technical Section of the British Paper and Board Makers' Association. Membership applications may be obtained from TAPPI, 122 E. 42nd St., New York 17, N. Y.

New York College of Forestry Alumni

The Editor of *Tappi* requested each college alumni group that met during Paper Week to give him a report of the meeting and a history of the meetings held to date. Following is a report submitted by T. A. Cook of W. R. Grace Co. dealing with the College of Forestry, State University of New York:

The first group to be graduated from the College of Forestry, State University of New York (then New York State College of Forestry) as pulp and paper majors was the Class of 1923. Since that time, 29 classes through 1951, there have been 435 graduates. Of this number, 389 or 89% are still in pulp and paper or allied fields, as follows:

Classification	*Number*	*Per cent*
Technical	179	41
Operating	123	28
Sales	59	14
Education	18	4
Allied	10	2
Total in field	389	89
Out of field	46	11

It was not until 10 years after the first pulp and paper class was graduated that plans were started for annual meetings during Paper Week. A few months before the 1934 TAPPI Convention, Prof. C. E. Libby wrote to W. R. (Bill) Willets, Class of 1925, who arranged for the first dinner meeting at Sacher's Restaurant on Madison Ave. About 20 attended. From this small beginning, the annual get-togethers have grown steadily in numbers, 165 attending the 1952 luncheon meeting in the Hendrik Hudson Room of the Hotel Roosevelt. A record of this growth is outlined below:

No.	*Year*	*Place*	*Chairman*	*Number present*
1	1934	Sacher's	Wm. R. Willets '25	20
2	1935	Sacher's	Wm. R. Willets '25	...
3	1936	Sacher's	Wm. R. Willets '25	27
4	1937	Sacher's	J. B. Atwater '29 G. B. Martin '27	...
5	1938	Waldorf-Astoria	....	...
6	1939	Sacher's	W. R. Willets '25	...
7	1940	Sacher's	W. R. Willets '25	...
8	1941	Cortile	C. G. Weber '16	43
9	1942	Commodore	R. T. Bingham '33	45
10	1943	Commodore	R. T. Bingham '33	48
11	1944	Commodore	R. T. Bingham '33	55
12	1946	Commodore	T. M. Cook '36	87
13	1947	Commodore	W. B. Morehouse '34	106
14	1948	Roosevelt	L. B. Sutherland '31	118
15	1949	Roosevelt	E. P. McGinn '31	115
16	1950	Roosevelt	E. P. McGinn '31	140
17	1951	Roosevelt	T. M. Cook	160
18	1952	Roosevelt	W. B. Morehouse	165

In reporting the historical activities of this group, very special mention and credit should be given to the tireless efforts of Prof. C. E. Libby, head of the Pulp and Paper Department. Professor Libby's unique quality of maintaining active interest and contact with the alumni after graduation has been a great factor in keeping our group united. Small recognition of his services to the alumni group was given in 1947 when a piece of Stickley furniture was presented to him.

Through these same years that we have been uniting during TAPPI Week, the College has had four fine Deans who have ever strived to improve the Pulp and Paper Department facilities and deserve special mention here. They are Deans F. F. Moon, Hugh P. Baker, Samuel N. Spring, and Joseph S. Illick.

Another group which has had an active interest in this branch of the college and has been influential in gaining the improvements for the Pulp and Paper Department is the Board of Trustees and especially those in the pulp and paper field. Among them are the late Senator J. Henry Walters; George W. Sisson, President of the Racquette River Paper Co. and for many years an active participant at our luncheon meetings during TAPPI Week; Frank C. Ash, President of the Oswego Falls Corp.; Charles Upson, President of the Upson Co.; and John P. Lewis, Jr., President of the J. P. Lewis Co.

The growth of our group somewhat parallels that of TAPPI, as over the years we seem to be about one-tenth of TAPPI in attendance at Annual Meetings. In drawing this parallel it is the hope and desire of the pulp and paper group of the College of Forestry, State University of New York, to serve the industry so as to bring credit both to the college and to TAPPI.

The background report of our activities, while brief, is intended to bring up-to-date what has transpired. Our increased activity within TAPPI, namely the inclusion of sectional alumni meetings at its sectional meetings, will be covered more completely as the events transpire.

In closing, this thought-provoking message from Harry E. Weston, Class of 1919, Secretary-Treasurer of the Superintendent's Association, is considered worth while. The message was written to the Dean of the College of Forestry in 1947 when Mr. Weston was Editorial Director of the *Paper Industry and Paper World:*

> The growing influence of graduates of the college upon fellow associates, their community, their state, and their nation is of more than just passing significance. It is something of immeasurable import.
>
> I can remember when Professor Libby and I were the only two representatives of the New York State College of Forestry at the Annual Meeting of TAPPI.
>
> It was pleasant to learn of the plans being made for the well-being of a growing institution but I do not recall anything being said about what is being done to *make better men.*
>
> I do feel definitely that there is an ever-increasing need for a fuller living of the Sermon on the Mount: *What is a man profited, if he shall gain the whole world, and lose his own soul?*

Whatever part of this job belongs to the college, I feel certain they acknowledge the task and are endeavoring to turn out better citizens as well as well-trained graduates. We of the alumni group hope we may contribute something by encouraging all alumni to participate in these meetings of good fellowship and by bringing to them messages such as has been possible these past three years from such distinguished leaders in the industry as Cecil Dawson, President of Dixie Cup, and Reuben B. Robertson, Chairman of the Board of Champion Paper and Fibre Co., and Fen K. Doscher, Vice-President in Charges of Sales of Lily-Tulip Cup Corp.

Canadian Summer Meeting

The Technical Section of the Canadian Pulp and Paper Association will hold an International Pulping Conference on June 16–18, 1952, and its regular Summer meeting on June 18–21, 1952, at the Manor Richelieu, Murray Bay, Quebec. Requests for hotel accommodations should be sent to J. G. Fisher, Assistant General Passenger Agent, Canada Steamship Lines Ltd., P. O. Box 100, Montreal, Que. Requests for programs should be addressed to Douglas Jones, Secretary, Technical Section, C.P.P.A. 3420 University St., Montreal 2, Que.

Fibrous Agricultural Residues Conference

The Fibrous Agricultural Residues Conference will be held at the Northern Regional Research Laboratory, Peoria, Ill., on Oct. 27–28, 1952. The Hotel Marquette in Peoria has reserved a block of rooms to accommodate individuals who may wish to attend this conference. S. I. Aronovsky of The Northern Regional Research Laboratory is Chairman of the Fibrous Agricultural Residues Committee.

Technical Associations

Following are the names of the principal organizations, similar to TAPPI, located outside of the United States:

Association Technique de l'Industrie Papetire, 154 Blvd. Hausmann, Paris 8, France, P. Delcroix, Secretary (Membership—571)

Australian Pulp and Paper Industry Technical Association, Division of Forest Products, Council for Scientific and Industrial Research, P. O. Box 18, South Melbourne, Victoria, Australia, R. W. Smith, Secretary (Membership—515)

Danish Paper Engineers Association, St. Strandstraede 18, Kopenhagen, Denmark, N. B. Nielson, Secretary (Membership—32)

Norwegian Paper Industry Technical Association, Stortingsgatan 14, Oslo, Norway (Membership—395)

Swedish Paper and Pulp Engineers Association, S. Blasieholmshamnen 4A, Stockholm, Sweden, Sven Westerberg, Technical Secretary (Membership—672)

Technical Section, British Paper and Board Makers' Association, St. Winifred's, Welcomes Road, Kenley, Surrey, England, Francis M. Bohan, Secretary (Membership—1370)

Technical Section, Canadian Pulp and Paper Association, 3420 University St., Montreal 2, P. Q., Canada, Douglas Jones, Secretary (Membership—1370)

Verein der Zellstoff-und Papier Chemiker und Ingenieure (Zellcheming), Ludinigsplatz 7, Darmstadt, Germany (Membership—780)

Folding Carton Forum

The TAPPI Lake Erie Section will hold a Folding Carton Forum at the Carter Hotel, Cleveland, Ohio, on May 22–23, 1952. This meeting will be sponsored jointly by the Section and the Research and Technical Committee of the Folding Paper Box Association. Room reservations may be made direct with the Carter Hotel or through the Folding Carton Forum Committee, Room 105, 1200 W. 9th St., Cleveland 13, Ohio. The program follows:

Thursday, May 22

10:00 a.m.–6:00 p.m.—Registration, Rainbow Room Lobby
11:00 a.m.–9:00 p.m.—Testing Equipment on Display, Embassy Room
1:00 p.m.–5:00 p.m.—Plant Visits to:
Trip 1—Great Lakes Box Co., and Dairypak, Inc., Cleveland, Ohio
Trip 2—Ohio Boxboard Co., Rittman, Ohio
Note: Only one trip can be taken by an individual. Buses will leave front door of Hotel Carter promptly at 1 p.m. Those who wish to make plant visits must register before 1 p.m. so that they will have trip tickets which will admit them to the bus and to the plant they visit.
6:00 p.m.—Informal Dutch Treat Dinner (Assemble at Registration Desk)

Friday, May 23

8:00 a.m.–7:00 p.m.—Registration, Rainbow Room Lobby
9:30 a.m.—Morning Session, Rainbow Room
(Moderator—F. D. Long, Container Corp. of America, Chairman, Research and Technical Committee, FPBAA)
"Problems in Manufacturing Board for Folding Cartons," by J. P. Wiedner, Container Corp. of America, Philadelphia, Pa.
"Folding Carton Manufacturing Problems," by F. H. Stowitts, Michigan Carton Co., Battle Creek, Mich.
"Meeting the Customer's Requirements for Folding Cartons," by Walter Sooy, Gardner Board and Carton Co., Middletown, Ohio
Discussion Period. Speakers and Michael Zales, Great Lakes Box Co., Cleveland, Ohio, sitting as a panel
12:00 Noon–2:00 p.m.—Testing Equipment on Display, Embassy Room
12:30 p.m.—Luncheon, Terrace A, Vocal Selections by du Pont Quartet
2:00 p.m.—Afternoon Session, Rainbow Room
(Moderator—L. K. Burnett, Ohio Boxboard Co., Chairman, Converting and Consuming Division TAPPI)

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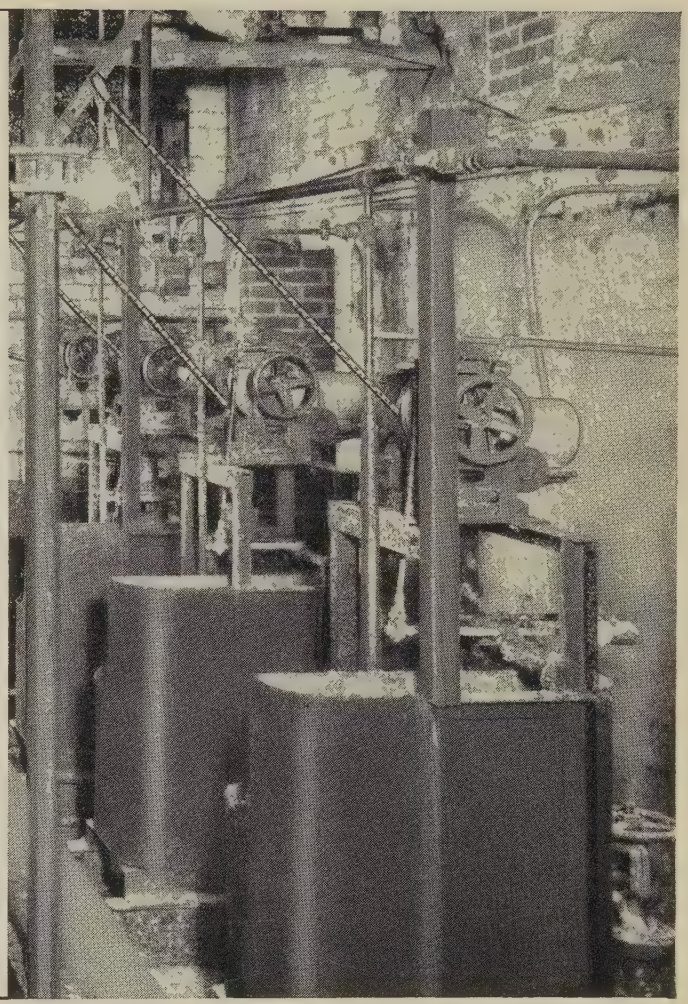

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"Folding Cartons from the Consumer's Viewpoint," by W. L. Romney, Procter & Gamble Co., Cincinnati, Ohio
"Testing Procedures for Folding Cartons," by L. R. Ayers, Robert Gair Co., Piermont, N. Y.
"Development of Folding Cartons," by H. S. Gardner, Fibreboard Products Co., Antioch, Calif.
Discussion Period. Speakers and Henry Bond, Richardson Taylor-Globe, Cincinnati, Ohio, sitting as a panel
4:30 p.m.–6:30 p.m.—Testing Equipment on Display, Embassy Room
4:30 p.m.–6:30 p.m.—Get-together Party, Terrace A
6:30 p.m.—Dinner, Rainbow Room
7:30 p.m.—Evening Session, Rainbow Room
(Toastmaster—W. Hasselo, Container Corp. of America, Chairman, Lake Erie Section of TAPPI)
"Future of Folding Paper Cartons," by R. S. Irwin, Summerville, Ltd., London, Ont., Canada
"Cooperative Research for Industry Development," by L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio

Statistics Conference

A conference on the application of statistical methods to the problems of the pulp and paper industry will be held under the cosponsorship of TAPPI and the University of Maine, Aug. 4–16. It is designed for research workers and quality control men in the paper industry. Its first purpose is to acquaint them with the applicability of statistical methods to their problems. Secondly, it is designed to give preliminary training to those individuals so that they may use statistical methods in research, production, and quality control.

The conference will consist partly of regular lectures, and laboratory periods, when there will be discussed the routine of applying statistical methods to mill problems. Secondly, speakers, from the industry, will discuss their experience with such applications. The regular lectures are divided into two parts as follows:

I. First and More Elementary Week

1. The chance variation of defects, like slime spots, which leads to control charts for fraction defective, to plans for sampling acceptance, and to the establishment of limits of variation.
2. The chance variation of measured characters, like strength of paper, which leads to control charts for average quality, range of quality, and to the establishment of limits of variation.
3. How to go about an investigation in the mill.

II. Second and More Advanced Week

4. The analysis of variation within and among reels of paper or batches of pulp and, alternatively, variation in properties, like basis weight, across and along a web of paper.
5. The anticipation of product properties, like corrugated board strength, from tests on constituents and the correlation of product quality with conditions in the mill .
6. The design of experiments in research and development.

The program will be conducted by four regular lecturers, Professor Spofford H. Kimball of the University of Maine; Charles A. Bicking, Research and Development Division, Ordnance Department; Professor Geoffrey Beall of the University of Connecticut, formerly of The Institute of Paper Chemistry; and Bary G. Wingersky, Chief Statistician, Gillette Safety Razor Co.

There will be each day a talk on difficulties and successes in actual application of statistical methods in the pulp and paper industry by nine speakers from the industry. This list is not yet complete but includes Maurice Blew, Strathmore Paper Co., on process control; John D. Hinchen, Monsanto Chemical Co. on applications of control charts in the Plastics Division of Monsanto; T. H. Geiger, Oxford Paper Co. on application of correlation analysis; and W. R. Purcell, Brown Co.

The conference is, essentially, planned for men with university degrees. It will be given only if 25 enroll but not more than 40 will be accepted, in either the first week (elementary) or the second week (more advanced) sections.

The regular lectures and laboratories will be given in the morning, 9:00 a.m. to 1:00 p.m. The talks on personal experience on application will be given in the evening. The afternoon will be free for recreation, for discussion of the morning's work with the lecturers, or for discussion of other problems with the lecturers. Two trips to nearby mills are planned for Saturday, Aug. 9 and 16, if this can be arranged.

Those wishing to attend may register for either week, with a fee of $110 or for both weeks with a fee of $180. Fees include room and board, as discussed below.

The men attending the Statistical Conference will be pretty much by themselves in one of the new University of Maine dormitories. The University will provide maid service, easy chairs, desk lamps, etc., in addition to its regular services and equipment. There will be a room for each man. All meals will be especially provided for the group and include waitress service. To summarize, the fees quoted above, provide for dormitory living with a number of added comforts.

In the case of men bringing their wives, the arrangements will depend upon how many such couples are involved. If there are few, they may have to shift for themselves in the town, which will be difficult. If, however, a reasonable number come, one of the older dormitories could be opened. For a couple, where the wife would take meals with the TAPPI group, there would be an extra charge of $40 per week.

Those wishing to register should write to Professor Spofford H. Kimball, University of Maine, Orono, Me. Registration fees are payable in advance by check payable to the University of Maine (but will be refunded by July 1, in case the registration is insufficient to justify the conference). The registration will be closed when it reaches 40 applications. Notices will be sent to all registered parties when the number reaches 25 and the conference is assured.

The following form should be completed and returned to Professor Spofford H. Kimball, University of Maine, Orono, Me.

I. In connection with the forthcoming Conference on Application of Statistical Methods in the Pulp and Paper Industry at the University of Maine, I wish to be registered for (check off)
   (a) The elementary week Aug. 4 through 9.
   (b) The more advanced week Aug. 11 through 16.
   (c) Both weeks Aug. 4 through 16.
II. I shall come (check off)
   (a) Alone.
   (b) With my wife.
III. I enclose check (or checks) of
   (a) $110 for one week alone.
   (b) $150 for one week, including room and board for my wife.
   (c) $180 for two weeks alone.
   (d) $260 for two weeks, including room and board for my wife.
IV. I am (check off)
   (a) Member of TAPPI.
   (b) Not a member of TAPPI.
V. I shall expect to be notified as soon as the registration is sufficient to assure the Conference and not later than July 1, if it is insufficient. In the latter event, I shall expect my fee to be promptly refunded.

Signed_____

Seventh Engineering Conference

of the

Technical Association of the Pulp and Paper Industry

Morrison Hotel, Chicago, Ill.

October 13–16, 1952

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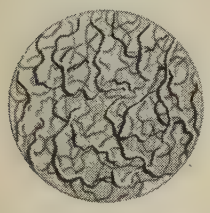
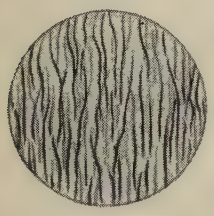
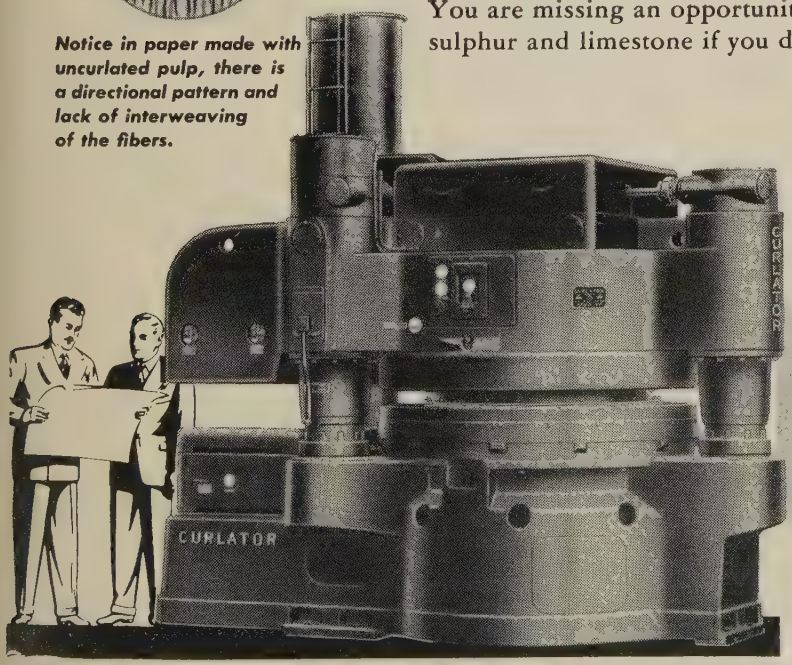


Notice that in paper made with Curlated pulp, the fibers are interlocked and lie in every possible direction.



Notice in paper made with uncurlated pulp, there is a directional pattern and lack of interweaving of the fibers.



CURLATOR† *Corporation*

565 BLOSSOM ROAD · ROCHESTER 10, NEW YORK

†T. M. Reg.—Curlator Corporation, Rochester, N. Y.

PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Jules E. Andre, Merchant, New York, N. Y.

Fred B. Atwood, Vice-President and Factory Manager, W. C. Ritchie & Co., Chicago, Ill., a 1931 graduate of Illinois Institute of Technology.

Phillip H. Avery, Student, Western Michigan College, Kalamazoo, Mich.

William Baehr, Librarian, Kansas State College, Manhattan, Kan.

Clarence F. Bickel, Sales Representative and Supervisor, The F. G. Findley Co., Milwaukee, Wis.

Robert F. Billue, Chief Chemist, Thiele Kaolin Co., Sandersville, Ga., a 1941 graduate of Martha Berry College.

George L. Booth, Research Engineer, Dilts Machine Works Div., Black-Clawson Co., Fulton, N. Y., a 1949 graduate of New York State College of Forestry.

Raymond J. Bowlan, Service Engineer, Oliver United Filter, Inc., Chicago, Ill. Attended Northwestern University.

George Brus, Director, Institut du Pin, Bordeaux, France.

John B. Canha, Paper Mill Design, Chas. T. Main, Inc., Boston, Mass. Attended Rhode Island State College and Massachusetts Institute of Technology.

Langdon Cheves, Vice-President, Daniel Construction Co., Greenville, S. C., a 1936 graduate of Clemson College.

Lorraine A. Ciboch, Librarian, American Can Co., Research and Technical Service Dept., Maywood, Ill., a 1947 graduate of the University of Illinois.

James T. Clarke, Student, Western Michigan College, Kalamazoo, Mich.

Sidney Conescu, Vice-President, Spear Box Co., Inc., New York, N. Y., a 1936 graduate of New York University.

John D. Cooney, Field Representative, National Aluminate Corp., Chicago, Ill., a 1942 graduate of the University of Michigan.

Lorne K. Crabtree, Mill Manager, Howard Smith Paper Mills Ltd., Crabtree Mills, P. Q., Canada. Attended McGill University.

Donald A. Cumfer, Paper Mill Superintendent and Chief Chemist, Mead Corp., Nashville, Tenn., a 1949 graduate of Vanderbilt University.

Donald R. Cushman, Chemist, Socony-Vacuum Oil Co., Inc., Brooklyn, N. Y., a 1937 graduate of Colgate University.

Louis-Noel Dambrine, Engineer, Societe des Pressoirs Colin, Montreuil-Sous-Bois (Seine) France.

Graham Davis, Engineer, Weyerhaeuser Timber Co., Pulp Div., Longview, Wash., a 1946 graduate of Northwestern University, and a 1951 graduate of Harvard Graduate School of Business Administration. On leave of absence in U. S. Navy.

Martin W. De Laarschot, Technical Staff, Hoberg Paper Mills, Green Bay, Wis. Attended St. Norbert's College.

Joaquin de la Roza, Sr., President, de la Roza Corp., New York, N. Y., a 1916 graduate of Cornell University.

Joaquin de la Roza, Jr., Vice-President, de la Roza Corp., New York, N. Y., a 1947 graduate of Cornell University.

Francis R. Di Franco, Chemist, National Adhesives Div., National Starch Products, New York, N. Y., a 1939 graduate of New York University.

James G. Dunlap, Jr., Student, Western Michigan College, Kalamazoo, Mich.

Lester R. Edwards, President and General Manager, Northeastern Container Corp., Bradford, Pa., a 1912 graduate of Illinois Institute of Technology.

Leon R. Eeman, Chemist, Brompton Pulp & Paper Co., Red Rock, Ont., Canada, a 1949 graduate of the University of British Columbia.

Manuel F. Escandon, General Director, Instituto Mexicano de Investigaciones Tecnologicas, Mexico, D. F., Mexico, a 1930 graduate of Massachusetts Institute of Technology.

Ralph H. Field, Research Assistant, New Products Development, Keyes Fibre Co., Waterville, Me., a 1950 graduate of Colby College.

Robert E. Fleming, Superintendent of Maintenance, Fleming & Sons, Inc., Dallas, Tex.

Victor H. Garlington, Salesman, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del, a 1941 graduate of St. Joseph's College.

Francoise Girard, Directeur du Centre de Controle du Comptoir des Textiles Artificiels, Paris, France, a graduate of l'Ecole de Physique et de Chemie Industrielles de Paris.

Stanley, J. Gillis, Publisher, Stonhill & Gillis Ltd., London, England. Attended Gravesend (County) Technical College.

Edward A. Glasheen, Student, Lowell Textile Institute, Lowell, Mass.

Albert E. Goldstein, Jr., Technical Supervisor, Gordon Cartons, Inc., Baltimore, Md. Attended the University of Maryland.

Paul R. Gravenstreter, Electrical Engineer, Clark Controller Co., Cleveland, Ohio, a 1939 graduate of Case Institute of Technology.

Edwin G. Greenman, Jr., Development Engineer, Midstates Gummed Paper Co., Chicago, Ill., a 1949 graduate of Illinois Institute of Technology.

G. Rurik Gustafsson, Secretary-Treasurer and Editor-in-Chief, The Finnish Paper Engineers Assn., Helsingfors, Finland, a graduate of Finland Institute of Technology.

David P. Habib, Research Director, Tecnifax Corp., Holyoke, Mass., a 1944 graduate of Brooklyn Polytechnic Institute.

Kenneth B. Hallas, Student, Lowell Textile Institute, Lowell, Mass.

Lars J. Hannunkari, Engineer, Oulu Osakeyhtio, Oulu, Finland, a 1946 graduate of Technical University, Helsinki.

Frederick C. Hartwell, Plant Chemist, Smith Paper Div., Peter J. Schweitzer, Inc., Lee, Mass., a 1945 graduate of Yale University.

Eugene T. Hawkins, Project Engineer, Johns-Manville Corp., Manville, N. J., a 1934 graduate of Rensselaer Polytechnic Institute.

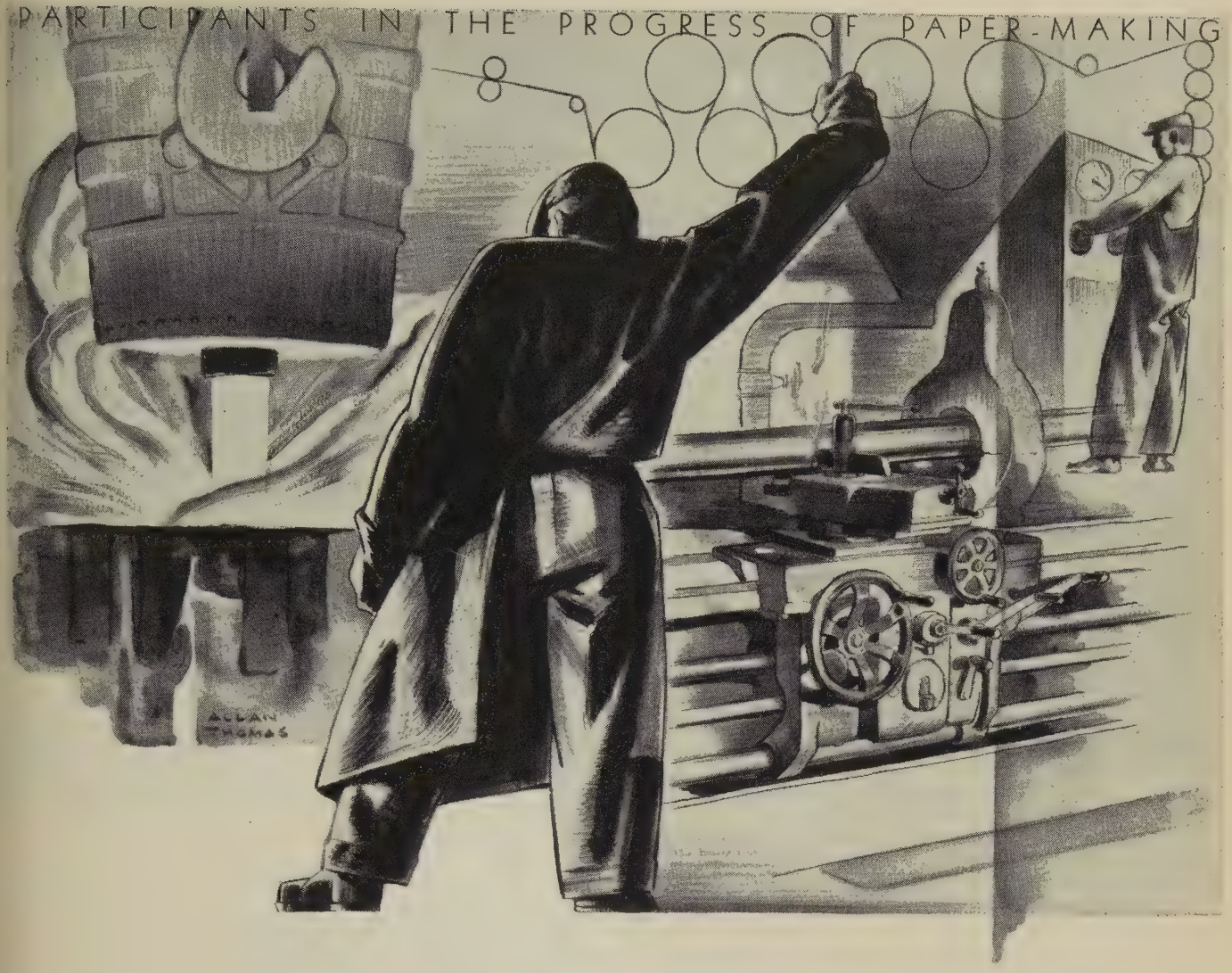
Alfred T. Hawkinson, Research Supervisor, E. I. du Pont De Nemours & Co., Inc., Electrochemicals Dept., Niagara Falls, N. Y., a 1925 graduate of Rutgers University.

Louis A. Hiett, Research Chemical Engineer, Buckeye Cotton Oil Co., Memphis, Tenn., a 1950 graduate of Georgia Institute of Technology.

Charles J. Higgins, Student, Lowell Textile Institute, Lowell, Mass.

Philip J. Hinkley, Technical Assistant to Superintendent of Pulp Div., S. D. Warren Co., Cumberland Mills, Me., a 1940 graduate of the University of Maine.

Yoshio Hori, Assistant Chief, Construction Headquarters,



Machinery . . . paper-making equipment traditionally combining original design and extremes of size with high speed operation, precision and durability . . . implements a great industry.

Fourdrinier Wires . . . as fabricated by Appleton Wire Works, Inc., reflect the 56 years of experience and devoted research that have *earned* the acknowledgement that *"Appleton Wires are Good Wires!"*

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Tomakomai Paper Mfg. Co., Ltd., Tokyo, Japan, a 1922 graduate of Tokyo Higher Technical School.

Anton J. Horstman, Director of Laboratories, The Bauer Bros. Co., Springfield, Ohio, a 1949 graduate of Michigan College of Mining and Technology.

Hideaki Hosaka, Chief of Pulp and Hardboard, Hokkaido Forestry Extension Service Station, Hokkaido, Japan, a 1941 graduate of Hokkaido University.

James M. Howard, Executive Vice-President, Lithcote Corp., Chicago, Ill.

Arvo I. E. Kautola, Engineer, Marathon Corp., Rothschild, Wis., a 1949 graduate of Finland's Institute of Technology.

Walter Kearley, Chief Chemist, Wall Paper Mfrs. Ltd., Perwale Greenford, Middx., England, a 1937 graduate of Queen Mary College, London.

Robert J. Kindl, Assistant Project Engineer, The Rust Engineering Co., Pittsburgh, Pa., a 1947 graduate of Carnegie Institute of Technology.

John R. Knapp, Student, New York State College of Forestry, Syracuse, N. Y.

Ralph E. Koester, Technical Representative, B. F. Goodrich Chemical Co., New York, N. Y., a 1940 graduate of the University of Wisconsin.

Milos Krofta, President and General Manager, The Ancram Paper Mills, Ancram, N. Y., a graduate of the University of Prague, with a Dr. Ing. degree from the University of Darmstadt.

Joseph H. Kuhns, Design Engineer, Marathon Corp., Rothschild, Wis., a 1940 graduate of Purdue University.

Homer L. Kurjan, Paper Technologist, C. H. Dexter & Sons, Inc., Windsor Locks, Conn., a 1943 graduate of New York State College of Forestry.

H. Clark Lind, Student, Lowell Textile Institute, Lowell, Mass.

Nils V. Mannbro, Chief Chemist, Marma-Langors Aktiebolag, Soderhamn, Sweden, a 1942 graduate of the State Technical College in Malmo, Sweden.

Albert J. Marchand, Student, Lowell Textile Institute, Lowell, Mass.

Robert L. Martin, Chief, Technical Library, Philadephia Quartermaster Research & Development Laboratories, Philadelphia, Pa., a 1940 graduate of Bethany College, and a 1942 graduate of George Peabody College.

Malcolm N. May, Technical Assistant, Champion Paper & Fibre Co., Pasadena, Tex., a 1947 graduate of the Rice Institute, with a Ph.D. degree from The Institute of Paper Chemistry in 1952.

Philip A. Monaghan, Technical Sales Service Div., Jefferson Chemical Co., Inc., New York, N. Y., a 1950 graduate of Pennsylvania State College.

Charles V. Morris, Vice-President, Reinhold-Gould, Inc., New York, N. Y., a 1926 graduate of New York University.

William Newfield, Chemist, Abitibi Power & Paper Co., Ltd., Smooth Rock Falls, Ont., Canada, a 1939 graduate of the University of Saskatchewan.

Robert J. Pelliccione, Student, Lowell Textile Institute, Lowell, Mass.

Henry F. Peters, Metallurgical Engineer, Lukens Steel Co., Coatesville, Pa., a 1949 graduate of Rensselaer Polytechnic Institute.

Francois Polack, Purchase Manager, S. A. des Cartonneries de La Rochette, Paris, France, a 1942 graduate of Ecole Polytechnique.

Warren S. Rushton, Student, Lowell Textile Institute, Lowell, Mass.

Thomas J. Sargent, Student, Lowell Textile Institute, Lowell, Mass.

Seppo M. Saukkonen, Chief of Semi-Chemical Mill and Research Laboratory, Veitsiluoto Osakeyhtio, Veitsiluoto, Finland, a 1949 graduate of the Technical University, Finland.

Harold M. Sawyer, Manager, Sales Development and Service, Vinyl Products, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., a 1939 graduate of Cornell University.

Raymond L. Schrock, Design Engineer, Shartle Bros. Machine Co., Middletown, Ohio.

Arthur W. Seward, Vice-President in Charge of Manufacturing, Ottawa River Paper Co., Toledo, Ohio, a 1928 graduate of Yale University.

George R. Shaw, Technical Adviser, Taylor Fibre Co., Norristown, Pa., a 1946 graduate of the University of Toronto.

Isao Shimoda, Consultant, Nihon Paper Mill Ltd., Tokyo, Japan, a 1929 graduate of Tokyo Imperial University.

Stanley A. Stadlen, Assistant Research Chemist, General Cable Corp., Bayonne, N. J., a 1949 graduate of the College of the City of New York.

Arthur Tournas, Student, Lowell Textile Institute, Lowell, Mass.

Paul Wasserman, Brooklyn Public Library, Brooklyn, N. Y.

Dorothy S. Wescott, Librarian, Rohm & Haas Co., Philadelphia, Pa., a 1921 graduate of Wellesley College.

Deane R. White, Director, Research Laboratory, E. I. du Pont de Nemours & Co., Photo Products Dept., Parlin, N. J., a 1927 graduate of Columbia University with a Ph.D. degree.

Frank A. Wilcox, Assistant to Director of Purchases, Kraft Foods Co., Chicago, Ill., a 1919 graduate of the University of Chicago.

Carl-Ulric Willers, Chief Engineer, Stromsnas Bruks A. B., Stromsnasbruk, Sweden, a 1927 graduate of the University of Stockholm and a 1929 graduate of the Technical University of Stockholm.

Leonard W. Williams, Manager, Technical Service, Lukens Steel Co., Coatsville, Pa. Attended Pennsylvania State College and Drexel Institute of Technology.

Roger S. Williams, Bacteriologist, R. T. Vanderbilt Co., Inc., Paper Mill Dept., East Norwalk, Conn., a 1951 graduate of Rutgers University.

Gabriel Wilner, Structural Engineer, Roderick O'Donoghue, New York, N. Y., a 1946 graduate of the College of the City of New York School of Technology.

Russell L. Wilson, Chemical Engineer, American Seal-Kap Corp., Long Island City, N. Y., a 1949 graduate of the University of Maine.

Frank S. Winship, Assistant to the Superintendent of Tissue Paper Mill, Personal Products Corp., Milltown, N. J., a 1951 graduate of New York State College of Forestry.

Hinoshi Yoneyama, Director and Mill Manager, Nomachi Mill, Tuetsu Pulp & Paper Industry Co. Ltd., Tokyo, Japan, a 1930 graduate of Tokyo Technical College.

Robert R. Young, Laboratory Technician, Pollock Paper Corp., Circleville, Ohio, a 1950 graduate of Ohio State University.

Edwin Zalehowski, Student, Lowell Textile Institute, Lowell, Mass.

Joseph E. Zinkevcz, Foreman, Moraine Paper Div., West Carrollton, Ohio. Attended the University of Wisconsin.

TAPPI Notes

Joseph Albert who has been ill in New Haven, Conn., for several months has returned to the Kennebec Div., Hudson Pulp & Paper Co., Augusta, Me., as an Industrial Engineer.

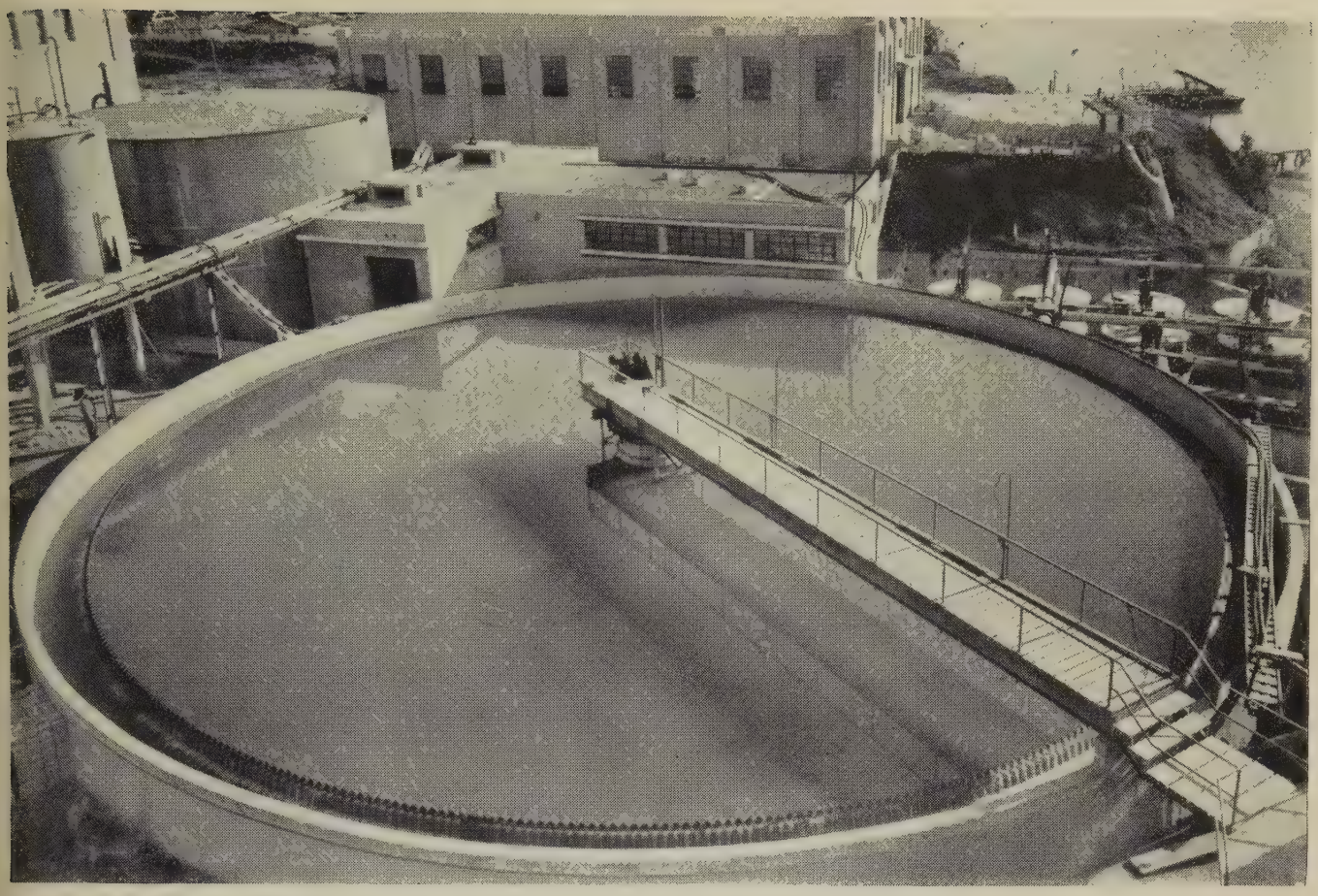
Gerald Alcorn is now Chief Construction Engineer for the Pulp Div., Weyerhaeuser Timber Co., Longview, Wash.

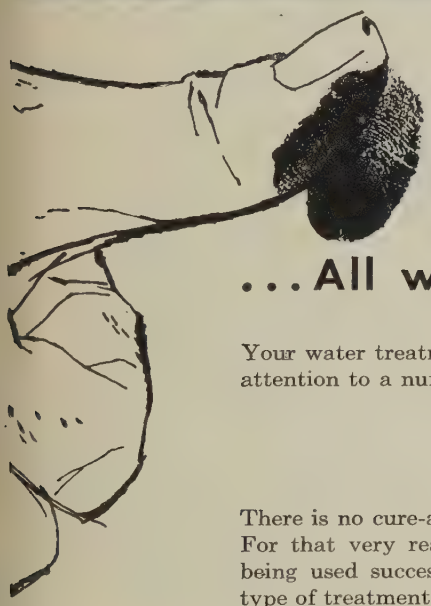
Paul C. Baldwin is now Assistant Vice-President of Scott Paper Co., Everett, Wash.

Ralph H. Ball of the Columbia Cellulose Co., Ltd., has transferred from Prince Rupert to Vancouver, B. C.

Paul V. Barrow, formerly of Connelly Containers, is now Production Superintendent for Federal Containers Co., Philadelphia, Pa.

Arthur A. Bernhardt, formerly Technical Supervisor of KVP Co., Ltd., is now with Nekoosa-Edwards Paper Co., Port Edwards, Wis.





Like Fingerprints

...All water treatment problems are different

Your water treatment problem can only be solved by paying special attention to a number of variables such as —

raw water composition
rate of flow
type of treatment
final result required

There is no cure-all for solving pulp mill water treatment problems. For that very reason, Dorr's experience and Dorr equipment are being used successfully by mills throughout the world. Whatever type of treatment you require — high rate or conventional — it will pay you to put our experience to work for you. And for more information about the many types of Dorr equipment available, ask for a copy of Bulletin No. 9141. THE DORR COMPANY, Stamford, Conn.

Every day, nearly 8 billion gallons of water are treated by DORR equipment.

ABOVE: Celulosa Argentina is the largest alkaline process pulp mill in South America. Located 200 miles above Buenos Aires on the Parana River, its clear process water is provided by two 90′ diameter Dorrco Hydro-Treators* which remove turbidity, color, and algae from 25 M.G.D. of river water. Turbidity removal has averaged 97% since initial operation of the Hydro-Treators, one of which is shown above.

*Reg. U. S. Pat. Off.

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Russell A. Bentz is now Vice-President in Charge of Manufacture for the P. H. Glatfelter Co., Spring Grove, Pa.

Harold E. Brakewood is now Technical Director of the National Folding Box Co., New Haven, Conn.

Maurice V. Brot is now located at Arpartado 42, Tomar, Portugal.

Thomas B. Calhoun, Sales Engineer of Oliver United Filters, Inc., has transferred from New York City to Fairhope, Ala.

Franklin E. Caton, formerly of the America Writing Paper Co., is now Resident Manager of Wilbraham Paper Co., North Wilbraham, Mass.

H. Lee Clack of the Dow Chemical Co. is now Chemist for Dow Chemical Inter-American Ltd., Midland, Mich.

Richard G. Coker is now Vice-President in Charge of Engineering for Sonoco Products Co., Hartsville, S. C.

Robert Q. Conner is now Plant Engineer for Crossett Paper Mills, Crossett, Ark.

George S. Douglas of the Mead Corp. has transferred from Leominster, Mass., to Chillicothe, Ohio, where he is Assistant to the Executive Vice-President.

Robert F. Dressler, formerly of the Riegel Paper Corp., is now Ensign in the U. S. Navy Officers School.

Mohammed Ekhlas, formerly Professor of Chemistry Muradi Chaud College, is now Senior Technical Officer in the Paper Mill Project, Chandraghona, East Pakistan.

K. O. Elderkin, formerly of Crossett Paper Mills, is now Manager of Bowater's Southern Corp., Chattanooga, Tenn.

E. O. Ericsson is now General Superintendent of Puget Sound Pulp & Timber Co., Bellingham, Wash.

H. C. Fromong is now Assistant Secretary of Evans Products Co., Coos Bay, Ore.

J. C. Clare Gain, formerly of Abitibi Power & Paper Co., is now Chemist for the Brown Corp., La Tuque, Que.

Roy A. Garnett is located at the new address of Whiting Corp. (Canada) Ltd., 185 Eileen Ave., Box 6, Station D, Toronto 9, Ont.

Armand M. Giguere, Plant Engineer of Marinette Paper Co., has transferred from Fort Edward, N. Y., to Marinette, Wis.

Athey G. Gillaspie, formerly of Hamilton Laboratories, is now Research Chemist for Champion Paper & Fibre Co., Hamilton, Ohio.

Henry Grabowski is now Pulp Mill Superintendent of Falls Paper & Power Co., Oconto Falls, Wis.

L. R. Growdon of the Mead Corp. has transferred from Lynchburg, Va., to Chillicothe, Ohio, where he is General Manager of the Board Div.

S. L. Guastello is now Assistant Research Director of the Fitchburg Paper Co., Fitchburg, Mass.

James C. Hair is now Mill Manager of the Crossett Paper Mills, Crossett, Ark.

Hugh T. Holland, formerly of the International Paper Co., is now Sales Engineer for the Merrimac Div., Monsanto Chemical Co., Everett, Mass.

Harry B. Hulse, Chemist, has transferred from the Thames River Div. to the Bogota Container Div. of Robert Gair Co., Bogota, N. J.

Jesse A. Jackson, Engineer for the St. Regis Paper Co., has transferred from Pensacola, Fla., to Jacksonville, Fla.

Robert A. Johnston, Chemical Engineer, formerly with Bathurst Power & Paper Co., Ltd., is now with the Industrial Chemical Div. of North American Cyanamid Ltd., Montreal, Que.

Paul Koenig is now Vice-President and Controller of P. H. Glatfelter Co., Spring Grove, Pa.

D. B. Kuhe is now in Charge of the Planning and Development Dept. of Crossett Paper Mills, Crossett, Ark.

Robert J. MacMeekin is now Chief Engineer of Economy Pump, Inc., Div. of C. H. Wheeler Mfg. Co., Philadelphia, Pa.

John A. McDermott of St. Regis Paper Co. has transferred from Tacoma, Wash., to Jacksonville, Fla.

William H. McPherson, formerly of the Mead Corp., is now with the Minnesota & Ontario Paper Co., International Falls, Minn.

Donald W. Michaelis is now Vice-President of Chas. W. Speidel & Co., Inc., Philadelphia, Pa.

J. Wayne Morrow is now Paper Mill Superintendent for Newton Falls Paper Co., Newton Falls, N. Y.

Dewey H. Nelson is now Sales Representative for Becco Sales Corp., Green Bay, Wis.

George B. Nicholson, Jr., is now Director of Laboratories, Dilts Machine Works, Fulton, N. Y.

Robert Nivison, formerly Vice-President, is now Consultant for Hollingsworth & Whitney Co., Waterville, Me.

Frederich Olsen is now Vice-President for Research and Development, Olin Industries, Inc., East Alton, Ill.

Karl Patrick of Fraser Cos., Ltd., has transferred from Atholville, N. B., to Edmundston, N. B., as Div. Chemist.

David F. Pollard, formerly of S. D. Warren Co., is now Engineer for the Great Northern Paper Co., Millinocket, Me.

Carl E. Price, formerly of Albany Felt Co., is now Research Engineer for the Celanese Corp. of America, Summit, N. J.

George W. Reynolds, formerly Engineer for Macon Kraft Co., is now with the U. S. Armed Forces.

William A. Robinson, formerly of Fibreboard Products, Inc., is now with the Hawaiian Sugar Planters Association Experiment Station, Honolulu, T. H.

Charles N. Rogers is now Head of the General Engineering Dept., Sonoco Products Co., Hartsville, S. C.

Richard C. Ruffer of the American Cyanamid Co. has transferred from Woodridge, N. J., to Valdosta, Ga., as Manager.

Douglas W. Shook, formerly of Kimberly-Clark Corp., is now Employment Supervisor and Payroll Administrator for Coosa River Newsprint Co., Coosa Pines, Ala.

Clifton W. Smith is now Production Manager for Crossett Paper Mills, Crossett, Ark.

Robert A. Stillings of Kimberly-Clark Corp. has transferred from Kimberly, Wis., to Neenah, Wis., as Process Control Technologist.

Edward H. Ungewitter, formerly of St. Marys Kraft Corp., is now Sales Engineer for Fibre-Making Processes, Inc., Chicago, Ill.

Paul H. Vonderhorst is now Chief Chemist for National Folding Box Co., New Haven, Conn.

Henry Vranian is now Assistant General Superintendent of Chesapeake Corp. of Va., West Point, Va.

W. J. Walker, formerly of St. Regis Paper Co., is now Consultant for Champion Paper & Fibre Co., Pasadena, Tex.

Christopher C. Wright is now Manager of the Paperboard Div., Minas Basin Pulp & Power Co., Ltd., Hantsport, Nova Scotia.

William R. Zwecker, Consulting Engineer, is now located at 1108 Oakdale St., Chicago, Ill.

* * *

James C. Hair, Mill Manager, has succeeded *K. O. Elderkin* as TAPPI official representative of Crossett Paper Mills, Crossett, Ark.

* * *

Albert O. Dyson, Manager of the Pulp and Paper Div. of Nichols Engineering & Research Corp., New York, N. Y., has succeeded *Harold E. Ingalls* as company representative in the Technical Association.

Joseph A. Kenney, Assistant New York Div. Manager, has succeeded *Ward H. Pitkin* as the official representative of Oliver United Filters, Inc., in TAPPI. Mr. Pitkin has been transferred to the Oakland, Calif., office as Assistant Sales Manager of the company.

Sutherland Refiner Ltd. has moved its offices from the Sun Life Bldg. to 1410 Stanby St., Montreal 2, Que. *James L. Brown* will be located at this address.

Specifications

FOR ONE SEVEN-ROLL
MACHINE CALENDER STACK

by

LOBDELL

This special purpose Lobdell Machine Calender Stack is simple and efficient in operation, easy to maintain and keep clean.

Specifications for this machine were set-up to suit the requirements of the particular job after consultation between our Engineers and our client's Engineers. Lobdell specializes in engineering particular applications to suit special needs.

Write for further information about this and other Lobdell Machine Calender Stacks. Lobdell also manufactures: Roll Grinding Machines, Micrometer Roll Calipers and Chilled Iron and Alloy Chilled Rolls.

1836

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WILMINGTON 99, DELAWARE
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1952

Pietro Ghisoni of Della Cartiera Vita Mayer Co. has returned to Milan, Italy, after a visit to the U.S.A.

Industry Notes

Swedish Production

Sweden's wood pulp production in 1951 was 10% higher than 1950 (3,488,000 tons). Exports, however, declined 4% last year under 1950 (2,305,000 tons). Paper production increased 10% over 1950 (1,301,000 tons), with exports remaining about the same as the preceding year, 954,000 tons. Paper exports to the United States increased 23% in the last two years, a 25% advance in newsprint and greaseproof paper being partly counterbalanced by reduced shipments of kraft wrapping paper and other grades.

* * *

Tree Farms

The American Forest Products Industries reports that there are now 3541 tree farms covering 24,863,238 acres. Texas has both the largest number of tree farms, 351, and the largest acreage, 3,133,349 acres.

* * *

Advances in 75 Years

In contrast to 1879 the U. S. population in 1951 increased 3.08 times (50,155,783–154,353,000); production of paper and board—57.7 times (452,017–26,086,115); wood pulp production—730.8 times (22,570–16,494,386); consumption of wood pulp—784.4 times (22,570–17,703,944); consumption of rags—1.9 times (200,005–389,434); consumption of waste paper—103.4 times (87,840–9,078,879); consumption of manila rope—decreased 74% (84,786–22,549); consumption of straw—1.6 times (245,838–501,397); and all other fibers—483.9 times (1218–589,429).

* * *

New Cigarette Filter

H & V Specialties Co., Inc., a wholly-owned subsidiary of Hollingsworth & Vose Co., East Walpole, Mass., has been formed to handle manufacture of Micro-Klean industrial filter cartridges. They are the sole producers of the filter material used in the new filter-tip Kent cigarettes, which recently appeared on the market.

* * *

Second Class Mail Rates

Second class mail rates increased 10% on April 1, 1952. Additional increases of 10% will be effected on the same date in 1953 and 1954 (S. 1046, Public Law 233).

* * *

Chlorine

The capacity of the chlorine industry, as of Jan. 1, 1952, was 2,670,000 tons, or a 7420-ton daily rate. The DPA's expansion goal is 3,430,000 tons by 1955.

* * *

Wholesale Price Index

The Bureau of Labor Statistics has issued a new Wholesale Price Index, based on 1947–49 averages equal to 100. It covers 1800 commodities as against 900 covered by the old index which was based on the average of 1926 as 100. Detailed information on the index, and in particular to the pulp and paper items may be obtained from Jesse M. Cutts, Chief, Branch of Industrial Prices, Bureau of Labor Statistics, Washington 25, D. C. The new index will be a more useful aid to business than the index it has superseded.

* * *

Taxes

Federal taxes are now taking close to two thirds of earnings of the paper industry before taxes. Mills working in a normal 30-day month now work 20 days for the government, and 10 days for the stockholders. Preliminary figures indicate that Federal income and profits taxes for 1951 in the primary paper industry alone reach $1,100,000,000. In some cases, 1951 taxes exceed the total amount of salaries and wages paid during the year.

* * *

Newsprint

The NPA reports that the combined United States and Canadian newsprint production for 1952 is expected to show an increase of about 3%. The anticipated U.S.A. production for 1952 is 1,150,000 tons (2.2% gain) and Canadian production is 5,690,000 tons (3.1% gain).

The expansion program for newsprint output, approved by the Defense Production Administration in November, 1951, provides for 494,000 additional tons a year by 1953. Certificates of necessity for rapid tax amortization have been approved for four paper-producing companies as follows:

Bowater Paper Co., Charleston, Tenn., proposed investment of $47,915,900 for the extra production of 125,000 tons annually. This is expected to come into production early in 1954.

West Tacoma Paper Co., Tacoma, Wash., proposed investment of $4,474,000, to provide 40,000 additional tons each year, due to become available starting in January, 1954.

Southland Paper Co., Lufkin, Tex., proposed investment of $15,040,000, to permit production of 60,000 more tons a year.

Publisher's Paper Co., Oregon City, Ore., proposed investment of $247,800 to provide for 4000 additional tons a year with no indication when this production will be available.

Two applications for tax certificates involving production of more newsprint are pending with DPA. They are: one by Michigan Paper Co., Plainwell, Mich., involving proposed expenditure of $1,500,000 to produce 11,000 ore tons each year, and one for the Great Northern Paper Co., Millinocket, Me., which proposes to spend $7,000,000 to expand facilities to produce 13,000 additional tons a year.

* * *

Hydrogen Peroxide

Expansion goals for hydrogen peroxide calls for 45,400,000 pounds by Jan. 1, 1955. This goal represents an expansion of 22,300,000 pounds over the Jan. 1, 1951, production capacity.

* * *

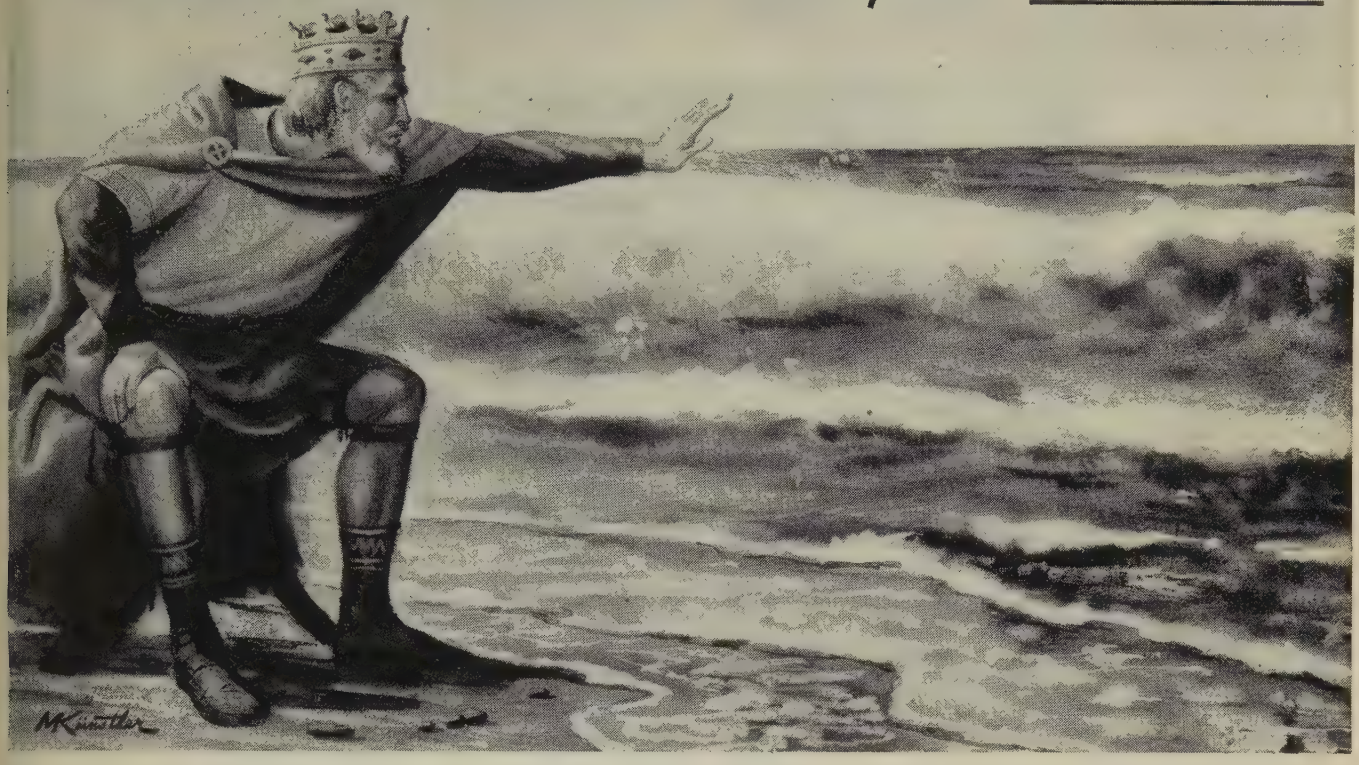
Waxed Papers

There are about 70 waxed paper manufacturers. Production in 1950 amounted to 400,000 tons, valued at $147,000,000. Five firms manufacture more than 33% of the production. The bulk of the production is in so called Zone 1, east of the Mississippi River and north of the Ohio River and the southern Virginia state line. The OPA has indicated the following CPR-130 ceiling prices, based on Zone 1.

The new regulation spells out base prices on most items, which are the delivered ceiling prices in Zone 1, together with differentials to cover deliveries in other zones. On other items freight differentials must be applied as in the base period.

Ceilings on printed bread wrappers and carton sealers, the major product of the industry, are determined by applying differentials covering make-ready, ink, special sizes, sheeting,

HE COULDN'T control foam, but YOU CAN



Years ago, King Canute the Great commanded the incoming tide to halt. But the sea advanced steadily, in lines of foaming breakers, until frothy, bubble-laden water lapped around the royal chair—forcing the royal occupant eventually to leave the beach.

Canute lost his battle with foam, but there's no reason why you should lose yours. Nopco* defoamers are at your disposal, affording "bubble busters" capable of eliminating obstinate foam conditions *within a matter of minutes.*

We particularly draw your attention to Nopco KFS. This remarkable foam killer provides an effective means of control *at every stage* in pulp and paper making where foam has to be "knocked down." Its lightning-fast action is of great advantage whenever foam tends to build up suddenly —as when induced by a surge of exceptionally foamy stock.

You'll find that KFS will do a real job of foam elimination, no matter how great the volume or speed of your production.

Write for our free bulletin, "Nopco KF* Series Dispersing Agents"; it gives valuable tips on how to improve sheet formation and suggestions for making stock emulsions. And remember, our specialists are always ready to assist you with technical aid right in your mill.

Foam formation is eliminated, and surface tension of water in stock greatly reduced, by spraying a dilution of 1/10 of 1% KFS through a battery of mist-type nozzles installed across the wire.

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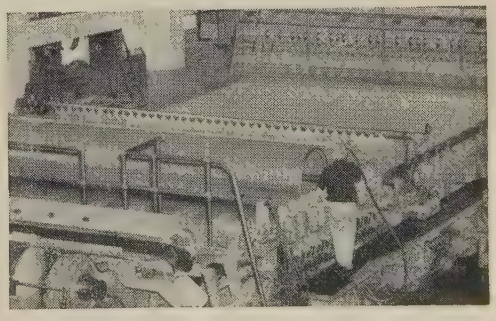

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bleed edges, color changes, special packaging, and other elements of costs, to base prices for the waxed paper.

Some of the base prices on important items, priced in carload lots, per hundredweight, are: Standard printed bread wrappers or carton sealers, opaque, $20.60; rotogravure printed, frozen food carton sealers, opaque, $33.05; standard printed supertransparent amber bread wrappers, $27.30.

Among the standard grades of unprinted waxed paper covered by spelled-out ceilings are the following for carload quantities, per hundredweight: 33-pound wet waxed, $18.45; 27-pound supertransparent, $25.50; 25-pound dry waxed, $19.20.

Ceiling prices on key interfolded paper items, in lots of less than 50 cases, include: 24-pound dry waxed or 25-pound greaseproof, sheet size 10 by $10^3/_4$ inches, $1.49 per thousand sheets; 12-pound interfolded tissue, sheet size 10 by $10^3/_4$ inches, $0.98 per thousand sheets.

Key item for household rolls in 17-pound stock, supercalendered and double waxed to 20 pounds, in 12-inch rolls, 125 feet in length, $10.45 per case of 48 rolls in carload lots.

To price any other grade of household rolls, a manufacturer takes the plus or minus differential between his base period price for the grade and $9.60, and applies the differential to the new 17-pound stock ceiling price of $10.45.

* * *

Waste Paper

Mill receipts of waste paper for the first quarter of 1952 are expected to be about 1,800,000 tons. This compares with 2,500,000 tons in the first quarter of 1951. Traditionally the second quarter is usually not as good as the first. If building restrictions are lifted soon there should be a greater demand for waste paper for roofing materials and building boards, into which go some waste paper.

In addition to supplying the wastepaper consuming mills of the United States with 9,252,000 tons of paperstock in 1951, the wastepaper industry collected and exported 206,438 tons to foreign countries. This tonnage was the greatest on record to foreign lands. Of the total amount, 102,383 tons were overissue news, and 104,055 tons of other grades of wastepaper.

Since no records are obtainable of the amount of wastepaper that is collected and sold for packing and shredding purposes, it is estimated that the total tonnage of wastepaper collected in the United States in 1951 exceeded 9.5 million short tons, about 125 pounds per capita.

Roughly, the reclaimed fiber used in the paper and paperboard industries amounts to nearly 35% of the total fiber used or about 7 million tons annually. This amount represents about 10 million cords of pulpwood.

* * *

Glatfelter

At the annual meeting of the Board of Directors of P. H. Glatfelter Co., Spring Grove, Pa., the following officers were elected: President—P. H. Glatfelter; Executive Vice-President and General Manager—P. H. Glatfelter III; Vice-President in Charge of Manufacturing—R. H. Bentz; Vice-President and Controller—Paul Koenig; Secretary—J. Russell Hoke; Sales Manager—F. B. Holmes. W. S. McClellan, former Vice-President in Charge of Sales, who has been with the company for 40 years, retired on May 1 but will continue as a Director of the company.

* * *

Gair

The following organization changes have been made in the Robert Gair Co.: Herbert A. Downing is now Manager of the Fort Niagara Corrugated Box Div., North Tonawanda, N. Y.; Frank E. Newton is Manager of the Ohio Corrugated Box Div., Cleveland, Ohio; Henry Rust is Manager of Gair's plant at Bogota, N. J.

George E. Dyke has announced the acquisition by Gair of the American Coating Mills Div. of Owens-Illinois Glass Co., Elkhart, Ind. The business will be carried on by American Coating Mills Corp., a wholly-owned Gair subsidiary with principal office in Chicago.

* * *

Union Bag

The woodlands held in fee or under lease and contract, including recent acquisitions in process of Union Bag & Paper Corp. are in excess of 800,000 acres. These woodlands would make an avenue of trees one-half mile wide extending from Savannah, Ga., to Seattle, Wash. The company's woodland acreage in relation to tons of pulp produced is among the highest in the industry.

* * *

Bowater

Bowater's Southern Corp. is setting up headquarters to proceed quickly on the construction of its newsprint and sulphate pulp mill in East Tennessee. $51,500,000 will be spent on American equipment and machinery. The mill will make 130,000 tons of newsprint and 50,000 tons of market sulphate pulp and should be in production in 1954.

* * *

Research

Ten reasons for research: (1) anticipate and prevent technological troubles; (2) cure existing troubles; (3) reduce cost of product; (4) increase utility of product or find uses for waste products; (5) reduce consumers' operating or maintenance costs; (6) develop new materials or products; (7) improve quality of existing materials or products; (8) bring about better standardization; (9) amass existing information leading to better understanding of product or process. (10) contribute to common store of general knowledge for long-term benefit.

* * *

Rayonier's Stainless Lined Digester

An additional digester, No. 5, is in the process of being assembled at Rayonier's Fernandina Div. under the direction of H. O. Pollei, Field Service Superintendent of A. O. Smith Corp. The digester was fabricated in subassemblies at the A. O. Smith plant in Milwaukee, Wis., and is the largest pressure vessel of its kind in the world, being 58 feet in height and 19 feet inside diameter.

The method used in the manufacture of the digester and the manner in which it will be assembled and tested present a picture of American ingenuity and "know-how" which is difficult to surpass. This digester is unique not only from the standpoint of size, but also the fact that it will be stainless-lined and of all-welded construction. The use of stainless lining obviates the necessity of lining the digester with acid-resistant brick which is the usual procedure for sulphite digesters.

Upon completion of prefabrication of various parts at the Milwaukee plant, the subassembly units from which the digester is being constructed were shipped in 12 knocked-down parts for the final field fabrication. Shipment in small units was necessitated by shipping size limitations.

The 12 subassembly units as received were assembled and welded on the ground into 5 units comprising the head, 3 shell courses, and the cone. These units were then moved into the building where they were rigged in place, beginning with the head, followed by the 3 ring courses and then the cone. Starting by welding the cone and lower shell course and working upward, the actual welding together of the 5 units is now being done.

Both shop and field carbon steel (base plate) welds will be

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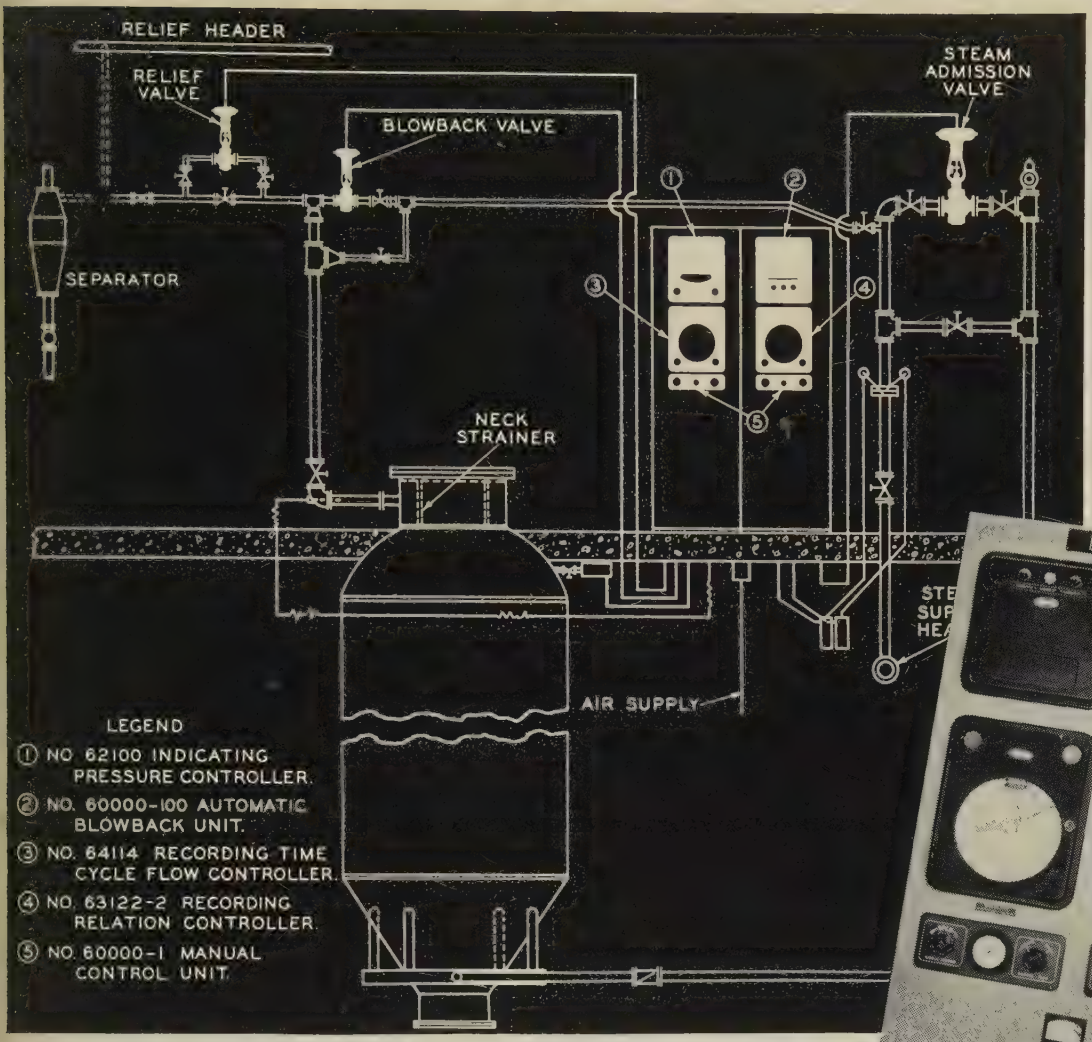

This Masoneilan system, which combines program control of steam admission, pressure-temperature relation control and automatic relief, is demonstrating substantial economies in many installations. Increased production (with fewer rejects) is the result of . . .

- **More Uniform Pulp—and often Increased Tonnage**
- **Better Bleachability**
- **Reduced Chemical Consumption**
- **Reduced Liquor Carry-over**
- **Lower Steam Consumption — and Graduated Demand on Power Plant**

If you are not fully informed on the advantages of this Masoneilan system we suggest that you ask for complete data.

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fully x-rayed and all alloy welds will be spot-check x-rayed. After the vessel has been completely fabricated it will be stress relieved by bringing the entire vessel to 1000°F. (cherry red heat) and held at this temperature for 5 hours. It will then be allowed to cool and will be finally given a hydrostatic pressure test of 205 pounds per square inch at the bottom of the digester and 180 pounds per square inch at the top to meet American Society of Mechanical Engineers Code Classification and Requirements. The digester will be carefully inspected during and after the hydrostatic test for any defects in the liner or base metal.

* * *

Nekoosa-Edwards

The multimillion dollar expansion program, largest in the Nekoosa-Edwards Paper Co.'s history, held top priority throughout the year in the drive to increase production facilities of both mills. The new Port Edwards warehouse was completed before the end of the year, construction work on the new machine building at Nekoosa was progressing satisfactorily, and fabrication of the machine itself and all the necessary auxiliary equipment was proceeding on schedule.

Actually, mill supervisors and engineers have worked for several years on preliminary plans and blueprints. Modernization of the Nekoosa kraft mill was begun about two years ago in preparation for the current expansion program. When completed, pulp production will be increased from 150 to 225 tons per day.

Wood room improvements already include a barking drum and a 10-knife chipper. Construction of a new chip storage building, slightly delayed by late delivery of steel, is now well along. The automatic chip handling conveyor systems, automatic weighing of chips en route to digesters, and chip blending systems both en route to storage and en route to digesters, facilitate and improve flow of materials through the pulp mill.

Digester building changes are completed and three new welded digesters of 3600 cubic feet capacity each are in place. Control consoles at each digester and a main instrument panel are provided so that chip conveying, weighing, and cooking are all controlled from the digester operating floor with scientific exactness.

Motor-operated blow valves on the digesters, stainless steel strainers, and an Impco brown stock washing system, plus new flat screens and valveless deckers, are included in the pulp mill modernization program.

The old batch causticizing plant has been replaced by a Dorr continuous causticizing system consisting of a lime slaker, white liquor clarifier, mud washer, and filters. Automatic control is an outstanding feature of the new installations, with control consoles located for utmost efficiency in operation. The new system will improve chemical recovery and reduce loss of sodium compounds.

The new No. 9 paper machine is expected to start production late in the Fall of 1952, and will increase production about 25 to 30%, depending on the grades of paper being manufactured. Construction of the new 400 by 65-foot machine room building was begun in January, 1951, and is now progressing fairly close to the planned schedule.

The machine will have a 180-inch wire and produce a web of paper 165 inches wide at an operating speed of up to 1200 feet per minute. It is a Pusey & Jones fourdrinier now being fabricated in Wilmington, Del.

* * *

Technical Man Power

The Engineers Joint Council, 29 W. 39th St., New York 18, N. Y., has issued a 16-in. by 22-inch poster entitled, "When Selecting Your Career Train Your Sights on Engineering." It states that, "There is a critical need for men trained to create new methods, materials, designs, structures, and processes necessary to America's future. This is providing countless long-range opportunities in engineering and science. If you are interested consult with your science or guidance teacher today regarding the qualifications necessary." These posters, with an accompanying letter, have been sent to high school principals throughout the country. Posters are available to individuals who will arrange to have them put on bulletin boards where high school students can see them.

* * *

Wellington Fund

In a letter to stockholders the $194,000,000 Wellington Fund of Philadelphia reported that it has increased its holdings of pulp and paper stocks because of their good long-term prospects. Holdings at the end of 1951 were: Crown Zellerbach (12,000 shares), International (5000), Marathon (10,000), Union Bag & Paper (14,000), Kimberly-Clark (14,000), and Weyerhaeuser Timber (9000).

* * *

Buckeye

Buckeye Cellulose Corp. (Procter & Gamble subsidiary) has started work on its $20,000,000 pulp mill at Foley, Fla. Completion of the plant is expected in the Fall of 1953. It will make 100,000 tons a year of nitrating and dissolving pulps. The plant will occupy 30 acres and employ 500 men. The company recently purchased 445,000 acres of timber properties in northern Florida from the Brooks-Scanlon Co.

* * *

Paper Industry in Russia

"In the 1951 edition of the Encyclopaedia of Greater Russia, there appears an article on the paper industry, in which is stated that in 1913 there were 212 paper and pulp mills in Russia, with 41,200 workers employed in these mills; at that time the industry was located principally in the Baltic Provinces and the area around St. Petersburg, which districts accounted for about one half of the production. Even in the period of the Tsars, the domestic industry could not satisfy even the most modest paper consumption needs. During the 1914–17 war years and in the period of revolution which followed, paper production dropped sharply, and it was only in 1925 that the industry came back to its 1913 production figure. Since that time the Soviet regime has laid down a very large program to build up a modern and strong paper industry and also to develop a sulphate pulp and paper industry.

"Before the last war the following large mills came into production: Djersjinski Mill in the Balkans in the vicinity of Gorkij (Nisjni-Novogorod), which is said to be one of Europe's largest newsprint mills, starting up in 1928 with an annual production of approximately 150,000 tons; Kondopoga Combine by Onega Sea operating by 1929; a sulphite mill at Siass in the Leningrad District, operating by 1930; a fine paper mill at Krasnovisjersk on the Visjera River in the Urals, operating by 1931; two sulphate pulp mills (Metsji and Solombal) and a sulphite mill at Archangel; the Marij Combine near Kasan east of Gorki, which manufactures insulating and other technical papers, operating by 1938; the Segesj Combine in distant Karelia, north of Onega which has a sulphate pulp mill, 70,000 tons annual production, and a kraft paper mill, operating by 1939; the Kamski Combine at Perm on the Kama River and a sulphite mill at Solikamsk in the same vicinity, operating by 1939 and 1941, respectively, and the Ingura Combine in Zugdidi in Georgia, operating by 1940.

"During the last war a good many paper mills in White Russia, the Leningrad District, and in Karelia were damaged, including the Kondopoga mills, but these plants have now been repaired or remodeled, and by 1948 production was already at the 1940 level. The armistice terms with Finland

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Your Camachine provides for fast change-overs from job to job. You can set up for a new run in a few minutes time, with quick, easy adjustments in strip width settings, threading, speed, tension, roll density and slitter wheel pressure. Optional equipment, operating in smooth, semi-automatic sequence (including rewind shaft injector, hydraulic riding roll lift, roll ejector and hydraulic roll lowering table) makes roll changes easy.

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Your Camachine is built to do a better quality job, to change swiftly from job to job, and to *stay* on the job. For detailed information please request your free copies of Camachine mill-type winder bulletins.

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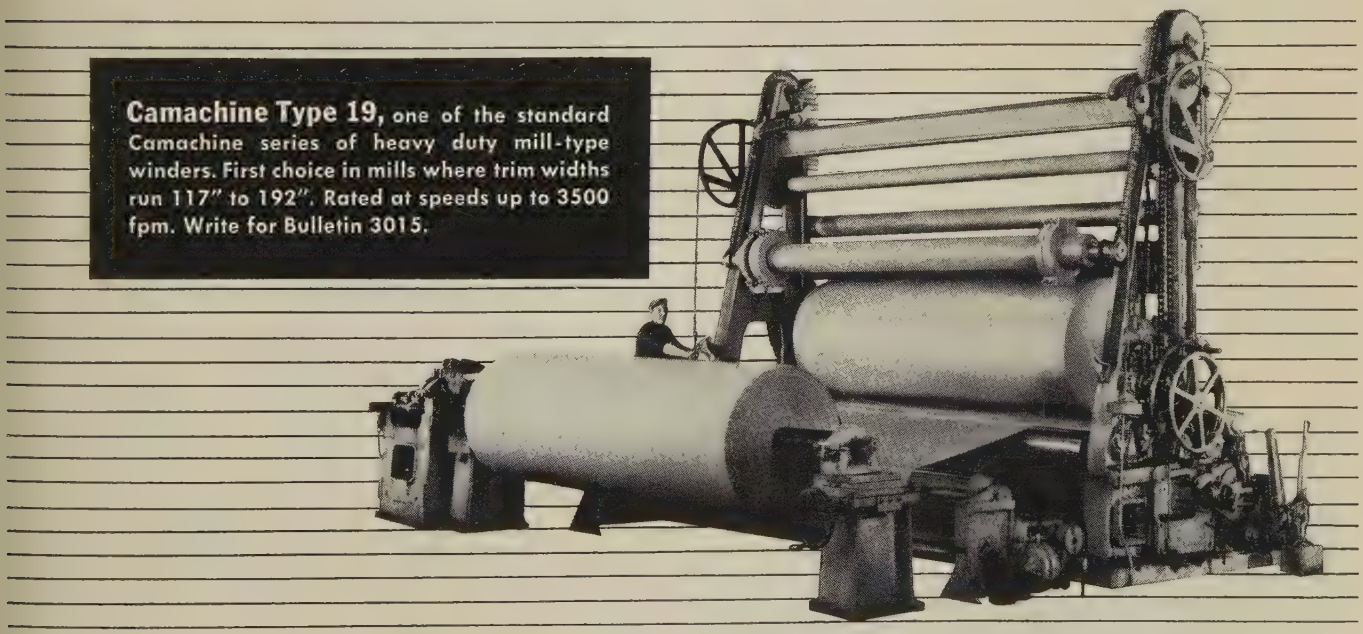

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turned over to the Soviet Union the majority of the pulp and paper mills in the Karelian Isthmus.

"The article from the Encyclopaedia goes on to say that in the next two years many new mills are projected, in addition to enlarging the facilities at Solikamsk to include a large newsprint mill. New mills are planned for Kamenogorsk (Leningrad District), Sverdlovsk (Ural), Nemansk (Tver District), Sjidatjovsk (near Smolensk), Rachovsk (Trans-Caucasia), Lwow (Lemberg in Poland), and Klaipeda (Memel). New pulp mills have already been built in Kalinin and on Sakhalin Island off the east coast of Siberia." (Translated from the Swedish by APPA Source: *Swedish Wood Pulp and Timber Journal*—Jan. 31, 1952.)

* * *

Sorg's 100 Years

John W. Erwin first came to Ohio's Miami Valley in the year 1828. In 1852 he and his brothers, Samuel and Edwin, built the first paper mill in Middletown, Ohio—forerunner of The Sorg Paper Co., now observing the one hundredth year of the founding of its business.

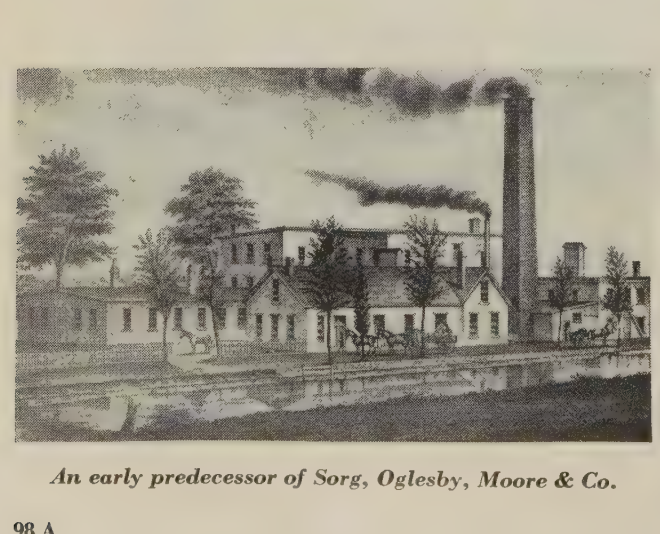
In The Sorg Paper Co. of today there are three divisions: Oglesby, Sorg, and Smith. Each Division has a varied history and pattern of success. Each event within that history took steps outward and onward toward growth, reaching maturity of the end of the first 100 years.

Millard Fillmore, 13th President of the United States, was in office when the history of Sorg began in the small mill the Erwin brothers built. By 1854, the aggressive firm was growing, and in May of the same year produced 65,000 pounds of fine paper and newsprint.

Later in 1854, the Erwin Brothers Co. was reorganized under the firm name of Oglesby, Tytus, Erwin, and Co. This move brought more capital into the company's treasury, enabling them to build an addition for the manufacture of blotting and book paper. The addition was completed in 1855.

The company prospered under the new organization, but already the rumblings of rebellion in the South could be heard as abolition of slavery became a burning social and political issue. The Civil War changed events for Middletown and the paper industry was greatly affected. The Oglesby, Tytus, Erwin, and Co. decided to sell its plant in 1865. The mill, however, remained in local hands, being organized again as Oglesby, Moore, and Co., incorporated with a capital of $200,000 in 1873. W. B. Oglesby was president and George C. Barnitz was secretary. In 1887 the mill became known as the W. B. Oglesby Paper Co. In 1902 the Oglesby mill was sold to the United States Playing Card Co. of Norwood, Ohio.

In 1917 the Paul A. Sorg Paper Co. bought the Oglesby plant which is today the Oglesby Division. Another subsidiary known as the Paul A. Sorg Realty Co. was founded in



An early predecessor of Sorg, Oglesby, Moore & Co.

The mill of A. Hill & Sons, one of the predecessors of Sorg

February, 1924, with a capitalization of a half million dollars.

Early in 1926, the Sorg Paper Co. employed engineers to make a study and prepare plans for a central power plant to furnish electric power, lighting, and steam for the company's three mills and office building. Construction of the new Power Plant was begun in May, 1927, and completed in June, 1928, at a cost of one million dollars.

On Jan. 2, 1931, the W. B. Oglesby Paper Co., The Frank Smith Paper Co., The Paul A. Sorg Paper Co., and The Paul A. Sorg Realty Co. were dissolved and merged as The Sorg Paper Co. The amount of capital which the new company began business with was $3,450,000.

Alex Hill, Sr., and sons, Alex and James, arrived in Middletown in 1854 and immediately started the erection of a mill for the manufacture of jute papers. This mill was built to compete with Erwin Brothers Co. which started operations in 1852. Hill and Sons operated their mill until the founding of the Hill and Peck Paper Co. in 1886, which was the first manila paper mill west of the Allegheny Mountains. This mill was located on the site of the present stock preparation room of Sorg, and is considered to be the direct forerunner of the Sorg Division.

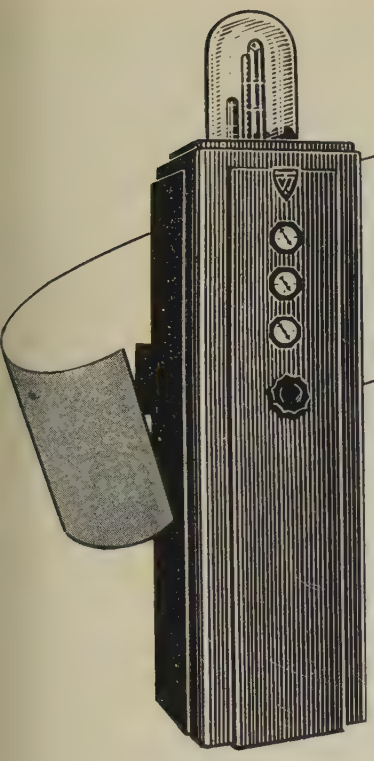
The new venture was started by two Scottish immigrants, Hill and Peck. They were the first men to manufacture manila paper made from jute and rope pulp in the West. Since much of the rope used was from the city of Manila in the Philippines, the paper received its name from that city. In those early days manila wrapping paper was a novelty. Housekeepers hoarded this paper, neatly folding each piece away and saving it for later use.

Hill and Peck advertised in *The Middletown Journal* in the Summer of 1866; "The manila paper mill, so-called from the kind of paper it manufactures, is owned by Messrs. Hill and Peck. It is the only mill of its kind in the West. The manila paper is much lighter and equally as strong as that of greater weight. It is very highly esteemed by our merchants and the enterprise will doubtless prove a success."

In the early eighties, the production of manila paper was about 30,000 pounds a day as compared with 800 pounds a day in 1866!

Fifteen years later, in 1881, Hill and Peck Co. was reorganized as the Middletown Paper Co. In 1895 it became The (George) Jacoby Paper Co., and in 1899, it was bought by Paul J. Sorg, a leading manufacturer and financier of Middletown. Paul J. Sorg was born at Wheeling, W. Va., in 1840 and died at Middletown in May, 1902. He was the son of Henry and Elizabeth Sorg who came to Cincinnati from Wheeling in 1851.

In the financial panic of 1898, the Jacoby Paper Co. failed and its affairs remained in the courts until November, 1899, when Paul J. Sorg bought the mill and rehabilitated it for his son, Paul A. Sorg. At this time, there were 57 employees producing 20,000 pounds of paper a day from two machines. In 1904, Paul A. Sorg married Grayce Aull of Pittsburgh,



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Faster...

Cheaper...

The machine is a W&T Visible Vacuum Chlorinator for the controlled and dependable application of chlorine to stock, white water and fresh water supply to destroy slime and odor producing micro-organisms.

It makes paper BETTER because by eliminating bacterial spots and off-odors it improves quality — obviously essential in food papers.

It makes paper FASTER because it reduces down-time due to sheet breakage, prevents the formation of slime in felts and improves water removal.

And, finally, it makes paper CHEAPER because it reduces stock, chemical and heat losses, improves grade and saves labor.

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whose brother, J. A. Aull, was later elected vice-president and president of the company successively.

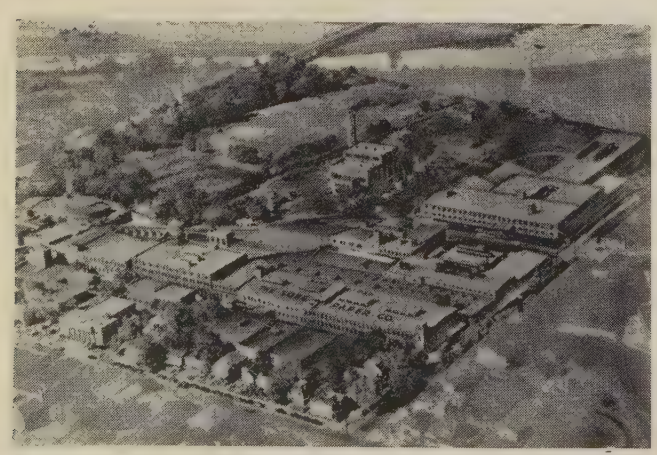
In 1905, A. Frank Smith left the Eureka Paper Co. of Fulton, N. Y., to become superintendent of the Sorg mill. On May 5, 1913, Paul A. Sorg died. In June, 1917, the company acquired controlling interest in the W. B. Oglesby Paper Co. This concern, equipped with two paper machines, was located adjacent to the Sorg mill properties. In the years that followed, the company was highly successful in the manufacture of fine papers such as bond, card, ledger, and printing. After several years of experimentation, it developed a fine grade of paper known as "Equator Offset" which was the first satisfactory offset paper produced in this country and was the acknowledged standard in the printing and engraving trades. The company also produced high grade papers for use in manufacturing playing cards.

On April 16, 1923, incorporation papers were filed for the Frank Smith Paper Co., another subsidiary of The Paul A. Sorg Paper Co., thus making the third major expansion of the company. This new company was capitalized for $1,500,000, and construction of the new mill was begun in 1923 and completed in January, 1925. The products of this mill, with a daily capacity of 120,000 pounds, included kraft papers of various weights, used for wrapping and in the manufacture of bags and gummed tape.

Paul A. Sorg

With nine years of successful business behind it, it became apparent to Sorg management early in 1940 that the company was facing a serious pulp shortage. The Scandinavian pulp which they had previously purchased, and upon which they depended for the bulk of Sorg operations, was no longer available because of the war.

The first ten months of 1940 were spent in surveying new sources of raw materials and analyzing anticipated needs of the Sorg mills. As a result, Sorg entered into a contract in November, 1940, with the Vancouver Kraft Corp., Ltd., by which Sorg agreed to buy the entire production of the Vancouver firm's Port Mellon Mill for a two year period. Early in 1941 Sorg decided that it should control the source of supply and exercised its option to buy the pulp mill in July, 1941. The mill was reorganized and was called The Sorg Pulp Co., Ltd., located on the west side of Howe Sound, 26 miles from Vancouver, B. C., Canada.



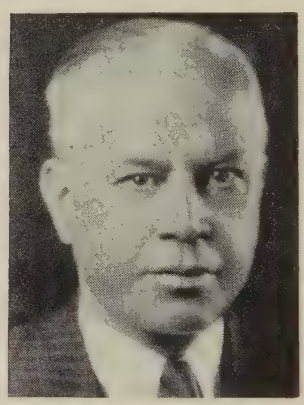
Air view of the Sorg Paper Co., Middletown, Ohio, as it appears today

During the war period, The Sorg Paper Co. operated on a seven days a week basis. Many improvements were made as equipment became available. During the period of 1940–42, a large modernization program took place. The stock preparation equipment in the Sorg and the Smith mills was replaced with the more modern hydrapulpers and refiners. At the time of its installation, this equipment was among the largest and most elaborate of its kind in the world. It replaced 16 beaters in the Sorg Mill and 10 beaters in the Smith Mill. This construction was carried on for a period of two years and only a small portion of production was lost during this period.

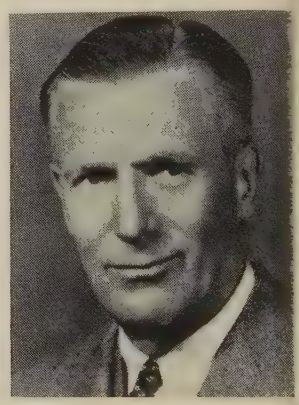
In 1945, a converting department was built due to the far-sighted view by Sorg management that there must be a close relationship between the fast-growing plastics industry and the paper industry. The first installation was pilot equipment on which experiments were made of numerous synthetic resin treatments which could add valuable characteristics to paper. After a series of pilot plant runs, a small manufacturing plant was built and completed about the middle of 1945.

Since that time, there has been much done in the way of research in other phases of converting. At present, Sorg is in the process of installing a new coating machine to handle synthetic plastics and their application to paper. Also operating in the converting department is an analine press. A rotogravure press is due to be installed within the next few months.

Also in operation at the present time is a tissue folding machine where the company's newest product, Kay-Pees, are converted into products being extensively used for dental towels and industrial wipes. Another converting operation is the making of magnetized cards which are used in conjunction with Magne-Dex files.



John A. Aull, Sorg Paper Co.



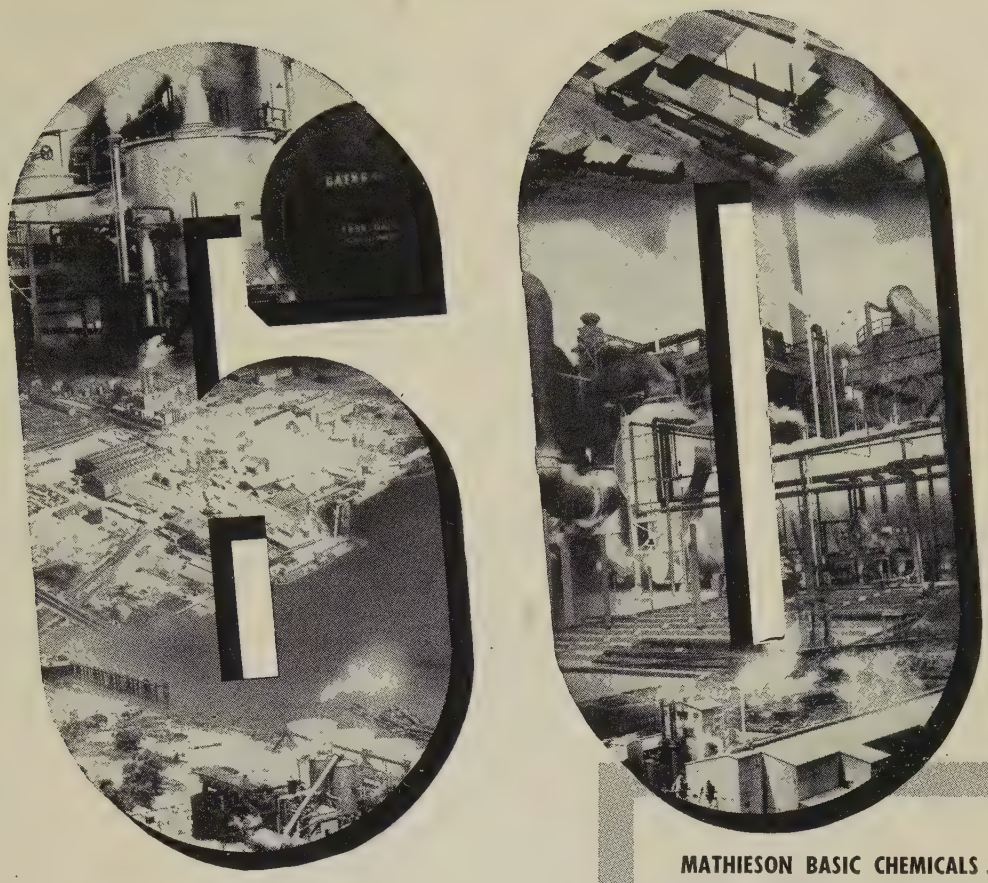
Donald G. Driscoll, Sorg Paper Co.

In 1947, the company expanded its Power Plant facilities by an extension with a new building and boiler. The boiler generates 120,000 pounds of steam an hour at 400 pounds per square inch pressure and 700 degrees temperature. In 1949, a new turbine was added. This new Power Plant addition gave The Sorg Paper Co. a much needed power capacity due to the stepped-up production of its six paper machines. Sorg's total power capacity could supply an entire city of 20,000.

In March, 1951, the Pulp Mill was reorganized and became known as The Howe Sound Pulp Co., Ltd., with Sorg retaining minority interest as well as a long-term pulp contract.

From its humble beginning to the present day, The Sorg Paper Co. has expanded and kept pace with the paper industry. Its record of quality papers places it in an enviable position in its industry.

The total assets of The Sorg Paper Co. today are close to fourteen million dollars, and as it embarks into its second century, it appears that the future is one of even greater achievement and expansion.



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- Sodium Chlorite
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Entering its 60th year as one of America's major chemical companies, Mathieson in 1952 will produce more basic chemicals and serve more vital industries than ever before in its history. From ammonia-soda process alkalies used by the early paper, glass, soap, petroleum and textile industries, Mathieson production has grown to include over 20 basic chemicals and their many specialized derivatives that today serve hundreds of manufacturers in this ever-expanding American economy.

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The modern-day history of Sorg really began in 1899 when Paul J. Sorg, a leading industrialist in Middletown, Ohio, bought what originally had been the Hill & Peck mill and established The Paul A. Sorg Paper Co. with his son, for whom the company was named, as its President. The company employed 57 men and had a production capacity of ten tons per day. Paul A. Sorg served as president of the company until his death in 1913 and was succeeded by John A. Aull, Sr., who had been the company's Vice-President since 1908.

With the election of John A. Aull, Sr., to the presidency, Sorg's expansion really began in earnest. In 1917 The Paul A. Sorg Paper Co. bought The W. B. Oglesby Paper Co., and in 1923 established The Frank Smith Paper Co.

Donald G. Driscoll, current president of The Sorg Paper Co. joined Sorg soon after his graduation from Yale in 1920 and was successively Assistant Purchasing Agent, Secretary, Assistant to the President, and from 1938 to 1944, Executive Vice-President. On June 1, 1944, when Aull became Chairman of the Board, Driscoll took over the presidency.

* * *

Groundwood Printing and Converting Papers

The Office of Price Stabilization has announced manufacturers' dollars-and-cents ceiling prices for 23 grades of groundwood printing and converting papers.

The agency provided, also, for pricing of another grade, that of coated enamel paper, at the price already established for coated enamel book paper.

The new ceilings were effective March 26, 1952. They are authorized in Ceiling Price Regulation 131. The new regulation provides, also, means for pricing special grades.

The level of ceiling prices set by the regulation approximates the level of current prices. The new ceilings are about 10% higher than prices frozen Jan. 26, 1951, by the General Ceiling Price Regulation, GCPR, but are below the prices manufacturers could have established under the Manufacturers' General Ceiling Price Regulation, CPR 22.

In the case of A-1 printing paper and related grades, the new ceilings are $1.00 or $2.00 per ton below current prices for about 70% of the production in these grades.

The purpose of the new regulation is to fix identifiable and equitable ceiling prices for manufacturers at levels consistent with the requirements of the Defense Production Act, and provide means of pricing adaptable to the practice of the segment of the paper industry concerned, the agency said.

It conforms with the policy prescribed in the so-called Capehart Amendment to the Defense Production Act by fixing ceilings not lower than the lower of (a) prices prevailing just before the issuance of the regulation, or (b) prices prevailing from Jan. 25 to Feb. 24, 1951.

The new regulation supersedes CPR 22 and applies to manufacturers' sales in the Continental United States. A manufacturer who acts as a paper merchant in selling his own products may, on a presentation acceptable to OPS, qualify as a paper merchant with respect to such sales and price them under Ceiling Price Regulation 112, Wholesale Paper Merchants.

Groundwood printing and converting papers are widely used by the printing and publishing industries for magazines, books, pamphlets, labels and wraps, wallpaper, and school and office supplies.

As defined by the regulation, they must contain more than 25% of groundwood pulp, which is wood pulp made by mechanical means in contrast with pulp produced by chemical processes. They do not include newsprint, wrapping, toilet, blotting, or towel papers.

The industry is concentrated in the Northeastern and Lake States, with about 75% of total production in Maine, New York, and Minnesota. There are about 30 mills making groundwood printing and converting papers, operated by 22 companies, of which five produce 65% of the total output. The industry produced about 880,000 tons of paper in 1951, valued at about $140 million.

About 70% of the product is sold by manufacturers to large industrial consumers, and 30% through wholesale paper merchants.

The 23 grades for which prices are spelled out represent about 75% of the production.

Another 20% is represented by groundwood enamel paper. Under the new regulation this grade is priced by reference to ceiling prices for enamel paper in Ceiling Price Regulation 106 (Coated and Uncoated Book Paper). CPR 106 established a ceiling price for 45-pound enamel paper in sheets, trimmed on 4 sides, on skids, in carload quantities, f.o.b. mill, lowest available freight rate allowed, of $12.10 per hundred weight.

The special pricing treatment accorded groundwood enamel paper recognizes that the same grade of paper is sometimes sold as book paper and sometimes as groundwood paper. Enamel paper is treated with clay, pigment, or other materials to provide a surface that will reproduce satisfactorily fine screen halftones.

Base prices are spelled out in the new regulation per hundredweight for 23 listed grades with specified minimum standard basis weights, packed in standard rolls, shipped in quantities of 36,000 pounds or more, f.o.b. mill, with the lowest available carload freight charges allowed, not to exceed $0.40 per hundredweight except for A Offset No. 1 grade.

Following are the base prices spelled out for the listed grades:

Grade	*Minimum standard basis weight 500 sheets*		*Base price per cwt.*
Printing Papers			
A Offset No. 1 (trimmed 4 sides, carload skids)	50 lb.	25 × 38	$12.90
A Offset No. 2	45 lb.	25 × 38	9.65
A Printing	40 lb.	25 × 38	9.45
A Printing, supercalendered	45 lb.	25 × 38	9.95
A 1 Printing	40 lb.	25 × 38	8.95
A 1 Printing, supercalendered	45 lb.	25 × 38	9.45
A 2 Printing	40 lb.	25 × 38	8.70
A 2 Printing, supercalendered	45 lb.	25 × 38	9.20
B Printing	40 lb.	25 × 38	8.55
C Printing	40 lb.	25 × 38	8.45
Specific Converting Papers			
Canary pencil tablet	32 lb.	24 × 36	9.00
B Carbonizing	35 lb.	24 × 36	10.35
B Coating	20 lb.	20 × 24	9.50
B Drawing	36 lb.	24 × 36	8.75
B Lining	16 lb.	17 × 22	9.25
No. 2 Hanging	38 lb.	24 × 36 (9 oz.)	8.75
General Converting Papers			
A 1 Converting	16 lb.	17 × 22	9.75
A 2 Converting	16 lb.	17 × 22	9.50
B 1 Converting	16 lb.	17 × 22	9.50
B 2 Converting	16 lb.	17 × 22	9.25
General Use Papers			
A mimeograph	16 lb.	17 × 22	9.75
Poster	32 lb.	24 × 36	9.25
Railroad Manila	14 lb.	17 × 22	9.25

* * *

Sulphite Spent Liquor Research

Active investigations by the Wisconsin pulp and paper industry covering fifteen major fields of scientific study designed to reduce sulphite pollution have now been divided into principal research fields.

Whole liquor research includes roadbinder, evaporation and burning, briquetting, and assorted other possibilities for using up all of the collectible spent liquor instead of flowing it into the stream.

Sugar research includes making torula yeast and other fer-

See General American for
CREATIVE EVAPORATOR ENGINEERING

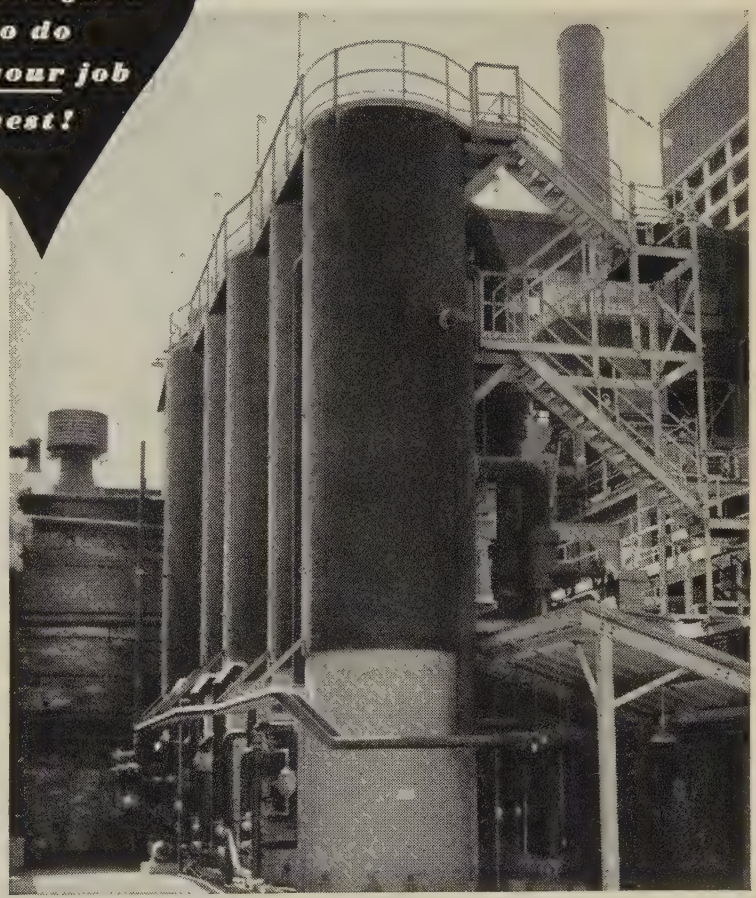
Conkey Integral Self-Supporting Evaporator needs less space—no housing. Easier installation! Greater capacity!

Designed to do your job best!

With simple design, simple operation, the Conkey Integral Self-Supporting Evaporator makes big savings wherever it is installed. Each effect of the evaporator combines in a cylindrical pressure vessel all these elements: a vapor body—centrifugal entrainment separator—heating element—condensate flash chamber and a supporting skirt. All structural supports are eliminated. Foundation is a simple slab footing.

The new Conkey Integral Evaporator is shipped fully assembled and a single up-ending operation sets it in place. Its vertical positioning saves floor or ground space, and where weather conditions permit, the entire unit may be installed outdoors. No housing is needed except for pumps and instruments.

Because its design reduces pressure drop losses between effects, the Conkey provides an increased working temperature drop across the heating element surface. Result: a net positive gain in evaporation—extra evaporating capacity. For complete technical information, write for Evaporator Bulletin.



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mentation processes for consuming the wood sugars from the liquor. Sugars are the most active element of the liquor in using up dissolved oxygen, and if they can be got rid of by preliminary treatment before disposing of the rest of the liquor, a substantial improvement is likely to result in the stream.

Lignin research has two branches. One of these deals with making useful chemicals from this dissolved material in the liquor, and the other deals with trying to make lignin insoluble. Several medical products derived from sulphite liquor lignin are being successfully used in treating diseases, and the chemists continue searching for new ones. Lignin can be made into good adhesives, but if the researchers can change the material so that these adhesives will resist water, this would open much wider markets. Lignin does not create serious problems when it goes into the stream, but the scientists are looking for ways to use it up after they take the sugar out of the liquor.

Recovery of chemicals used in the pulping process is the scientists' fourth research field. These are relatively unimportant factors in sulphite pollution, but if the chemists can take them out of the spent liquor for reuse, this will restore the water flowing out of the mill just that much closer to the condition in which it was first pumped from the river.

* * *

Pulp, Paper, and Paperboard Expansion Goals

Expansion goals for wood pulp, paper, and paperboard were announced recently by the Defense Production Administration. Establishment of the goals permits the DPA Office of Resources and Expansion to complete action on applications now pending for certificates of necessity for rapid tax amortization.

However, since the expansion goals in the pulp, paper, and paperboard industries have been filled in the aggregate, either by necessity certificates already certified or by applications pending, no more such applications will be accepted by DPA.

The Jan. 1, 1956, expansion goals set for the paper and paperboard and wood pulp industries, compared with Jan. 1, 1951, capacity, are as follows:

1. Paper: Additional expansion of 1,483,000 short tons to increase annual capacity to 14,268,000 tons from 12,785,000 tons.
2. Paperboard: Additional expansion of 895,000 tons to increase annual capacity to 13,030,000 tons from 12,135,000 tons.
3. Wood Pulp: Additional expansion of 3,313,000 tons to increase annual capacity to 19,048,000 tons from 15,735,000 tons.

DPA pointed out that the pulp, paper, and paperboard expansion goals do not include fiber building board because this material is treated separately from paperboard in DPA and in the National Production Authority's commodity-industry Divisions.

The types of pulp, paper, and paperboard production for which no further Government aid will be given for expansion because the established goals have been filled by increased production already authorized by the granting of rapid tax amortization certificates are as follows:

Coarse Papers, including shipping sack and special industrial types, an increase of 480,000 short tons to an annual capacity of 4,280,000 tons by 1956. Production capacity on Jan. 1, 1951, was 3,800,000 tons.

Absorbent Paper, no further expansion is provided for. Capacity on Jan. 1, 1951, was 135,000 tons annually, and this is the amount determined as needed by Jan. 1, 1956.

Building Paper, an expansion in annual capacity of 10,000 tons over the Jan. 1, 1951, annual capacity of 1,575,000 tons is authorized, bringing 1956 annual capacity to 1,585,000 tons.

Container Board, an expansion of 563,000 tons by 1956 is authorized, bringing total production up to 6,970,000 tons annually. Production capacity on Jan. 1, 1951, was 6,407,000 tons.

Folding, Set-up, and Miscellaneous Paperboard, an expansion in annual production of 320,000 tons by 1956 is authorized, bringing total annual production capacity up to 5,804,000 tons. Production capacity on Jan. 1, 1951, was 5,484,000 tons.

Cardboard, an increase in annual production of 12,000 tons by 1956 is authorized, bringing annual total capacity up to 96,000 tons. Capacity on Jan. 1, 1951, was 84,000 tons.

Wet Machine Board, no expansion authorized. Industry capacity on Jan. 1, 1951, was 160,000 tons, sufficient to meet projected demand for the beginning of 1956.

Unbleached Sulphate Wood Pulp, an expansion of 1,034,000 tons is authorized to bring the capacity up to 7,212,000 tons a year by 1956. Capacity on Jan. 1, 1951, was 6,178,000 tons.

"All Other" (Miscellaneous grades) Wood Pulp, an expansion of 119,000 tons is authorized to bring total annual capacity up to 2,044,000 tons by January, 1956. Production capacity on Jan. 1, 1951, was 1,925,000 tons.

Other paper and wood pulp expansion goals are set forth below. For these products only relatively small tonnages still remain open for DPA approval action.

Newsprint, the previously established goal of 1,590,000 tons a year by 1956 is unchanged. This amounts to an increase of 494,000 tons from the industry capacity of 1,096,000 tons annually on Jan. 1, 1951.

Groundwood, Machine Coated, and Book Paper, an expansion of 225,000 tons is approved, to bring total capacity up to 3,658,000 tons a year by 1956. Capacity on Jan. 1, 1951, was 3,433,000 tons.

Fine Papers and Miscellaneous, an expansion of 274,010 tons annual capacity is approved, to bring total annual capacity up to 4,020,000 tons by Jan. 1, 1956. Capacity on Jan. 1, 1951, was 2,746,000 tons.

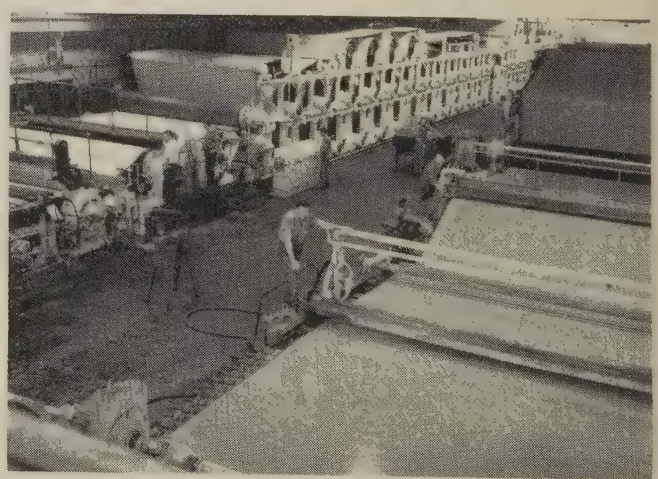
White Pulp (including dissolving wood pulp), an expansion of 1,440,000 tons in annual capacity is approved, to bring total annual capacity up to 6,795,000 tons by 1956. Annual capacity on Jan. 1, 1951, was 5,355,000 tons.

Groundwood Pulp, an expansion of 720,000 tons in annual capacity is approved to bring total annual capacity up to 2,997,000 tons by 1956. Capacity on Jan. 1, 1951, was 2,277,000 tons.

* * *

West Virginia

West Virginia Pulp and Paper Co.'s broad postwar rehabilitation program at the Covington, Va., mill moved forward another step today when plant crews completed work on a $1,500,000 improvement project in the paper mill.

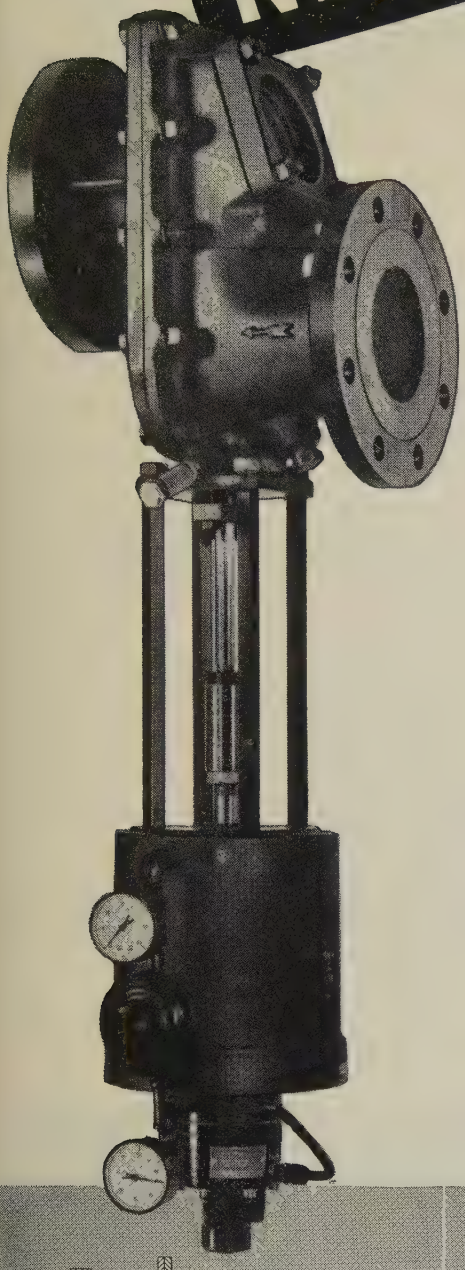


View of No. 6 (foreground) and No. 7 paper machines at the Covington, Va., plant of West Virginia Pulp and Paper Co., which were rebuilt recently. Here crewmen carefully check performance of machines after startup

NEW

F & P RATOGATE SLURRY FLOW CONTROL VALVES

- ***Wide-Range***
- ***Self-Cleaning***
- ***Non-Plugging****
- ***Minimum Friction***



Entirely original, revolutionary in design, these new F&P pulp and paper stock valves create pronounced, visible turbulence in the inlet area, yet discharge a smooth, even flow. Stock simply cannot collect to cause plugging even at extremely low flow rates. Lack of the usual gate or plug guides minimizes friction, makes sensitive flow control possible over the entire wide-range of operation.

A RATOGATE Valve plus the well-known F&P RATOSLEEVE flow meter and RATOMATIC flow controller make up a complete, positive, and precise automatic flow control system for proportioning slush stocks and for liquid level control.

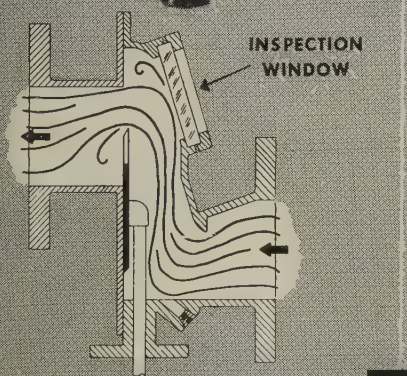
Applications include flow control of lime, starch, and carbonate slurries, automatic proportioning and level control systems for handling pulp or paper stocks and similar slurries for pulp fiber recovery systems.

Stainless steel is the standard material of construction. Other materials are available. Valves have polished stainless steel stems and sliding gates. Connections are 150# standard ASA flanges.

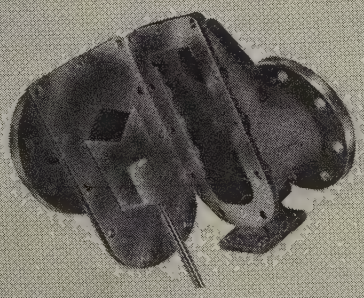
*HERE'S THE REASON . . .
there's no plugging in RATOGATE valves

This line is the actual size and shape of the outlet port of "through-flow" slurry control valve if it were passing 30 GPM of 4% A.D. pulp.

Here is the outlet port of the new 4" RATOGATE Valve which controls less than 30 GPM of 4% A.D. stock without plugging. The diamond shaped port is superior because it offers a minimum perimeter for the area of opening.



CROSS SECTION OF RATOGATE VALVE SHOWING FLOW LINES WHEN GATE IS LESS THAN HALF OPEN.



DIAMOND SHAPE PORT PROVIDES MINIMUM PERIMETER FOR OPENING AREA.

WRITE FOR COMPLETE INFORMATION

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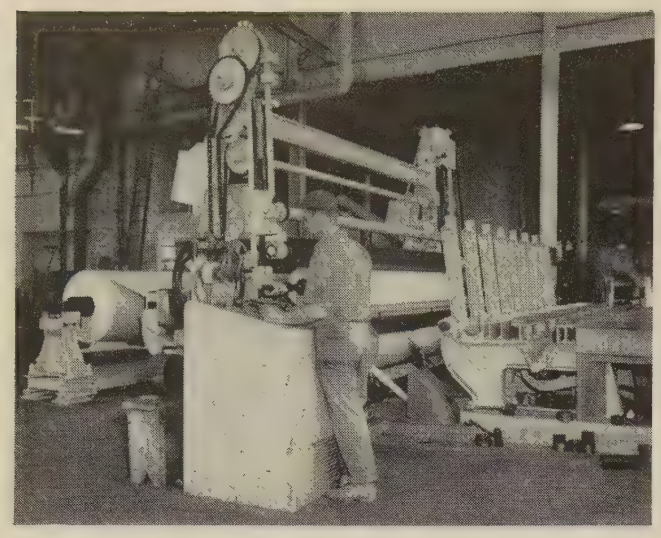


Two Cameron rewinders were rebuilt and relocated immediately behind No. 6 and 7 machines at Covington, Va., plant of West Virginia Pulp and Paper Co. to provide a straightline operation. Here Newman Leffel, third hand, operates controls of No. 7 rewinder, to which has been added such labor-saving devices as roll ejector mechanism, automatic shaft pullers, pneumatic slitters and pneumatic trim handlers

The project covers the rebuilding of Nos. 6 and 7 paper machines, the remodling and rearrangement of the stock preparation layout and realignment and modernization of rewinding and roll finishing operations serving these machines, and construction of an addition to the machine room to accomodate the new streamlined operations.

Completion of the major phases of this immediate program was marked by the start-up of No. 7 paper machine, a prime producer of important grades of paper made at Covington, which had been shut down for almost two weeks while new parts and units were being added to its 224-foot frame.

Plant officials pointed out that these improvements, like others carried out since the end of the war, are designed primarily to improve the quality and uniformity of the product, to effect economies through more efficient operations, and to maintain the greatest degree of flexibility possible for a mass production mill. No material boost in production is expected for some time it was stated.

Current paper mill improvements represent the fourth phase of an extensive rehabilitation program designed to restore the Covington mill to the competitive position it enjoyed during the 1920's. Since the war, the company has spent in the neighborhood of $30,000,000 in Covington and has allocated several millions more for future projects already authorized.

Major improvements already effected or in the final stages of completion include fuller mechanization of the pine and hardwood yards, the rebuilding and consolidation of the plant's pulp mills to permit freer use of abundant hardwoods in this area and reduce the quantity of scarcer pine wood used in pulp manufacture, and the rebuilding of No. 5 paper machine, the top producer of the seven machines now operated at Covington.

Work is also nearing completion on certain phases of a modernization program for the Recovery Department, where chemicals from waste pulping liquors are recovered and processed for reuse. This includes the rebuilding of one rotary furnace used for liquor burning, placed in operation this week; installation of a new modern causticizing plant, complete with a 350-foot lime kiln capable of producing as much as 275 tons of lime per day, and installation of an additional sextuple-effect evaporator used to concentrate waste liquors prior to the burning process.

The next major project on the schedule is installation of a completely new and modern paper machine, to be designated as No. 8. This machine, which will be built on the sites now occupied by Nos. 3 and 4 machines, will replace older, inefficient paper-producing equipment. The machine will have a 216-inch wire and will measure 430 feet from the headbox to the reel. Preliminary work on this project already has begun, but the actual installation of the machine is not scheduled until late fall.

Projects related to the rebuilding of Nos. 6 and 7 machines required months of precision engineering and technical planning. In addition, many weeks of work to prepare auxiliary operations for the change, and weeks of preliminary work at the site—installing electric and steam connections, pouring new foundations, assembling larger units as they were received from the manufacturers, and moving these and smaller units to the site—were necessary before actual work on the machines began.

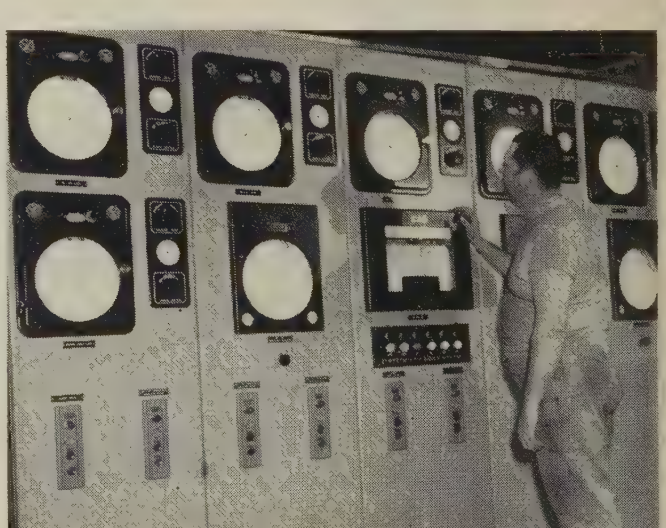
Working round the clock, plant construction and maintenance crews, assisted by members of the machine crews and representatives of suppliers who manufactured the major units for the machines, managed to rebuild each of the machines in less than two weeks.

In order to carry out the tandem job with a minimum of production losses, the crews first completed necessary shifts in the stock preparation layout required for the rebuilt machines. This called for extensive rearrangement of the beater room. New stock proportioners—compact, precision-controlled pulp furnishing installations—replaced continuous mixers and thickeners which had been used for over 25 years. The new stock metering units are operated by push-button controls, are equipped with electrical devices to chart the exact flow of different types of pulp needed to make up the furnish for a particular grade of paper, and automatically control the flow in relation to the production requirements of the paper machine.

While both machines maintained full production, the crews also relocated six jordans on the main beater room floor to serve No. 6 machine, installed three large new refiners to serve No. 7 machine, and relocated two smaller ones for future service to No. 8 machine.

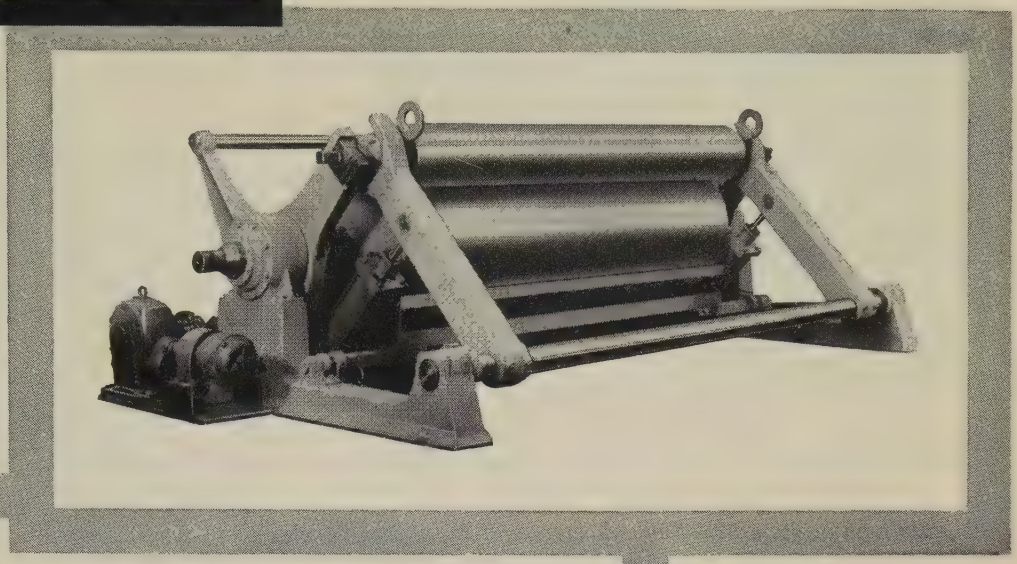
At the same time construction crews were clearing the south end of the finishing and loading department and were erecting in their place an addition to the machine room. This brick and steel extension, measuring 80 feet in width, 96 feet in length, 28 feet in height, was completed in 15 weeks.

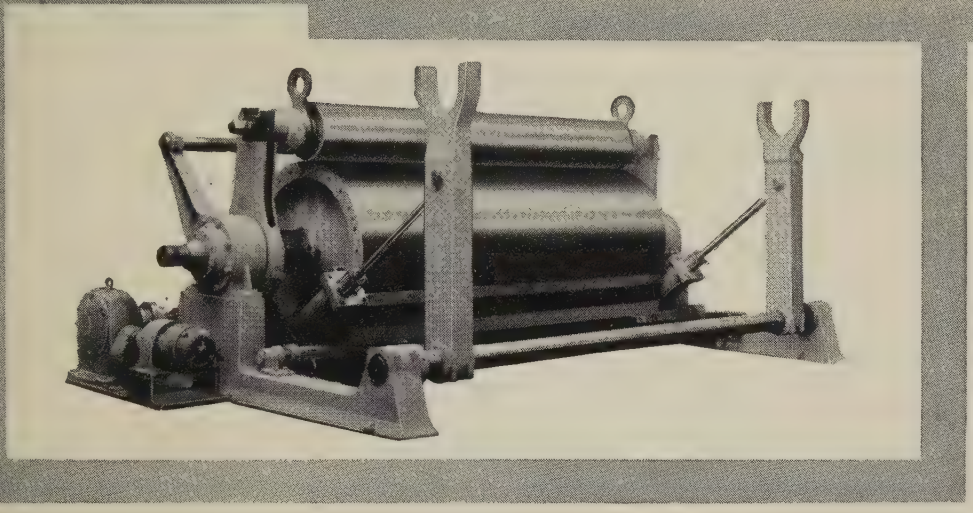
The preliminary work ended, No. 6 machine was shut down February 17 and its production of nine-point board, an essen-



The new stock metering system at the Covington, Va., plant of West Virginia Pulp and Paper Co. is completely instrumented. Here Forrest L. Andrews, beaterman, checks an operational chart of No. 7 pulp metering control panel

an improved and simplified reel by Black-Clawson





Here is a Black-Clawson improved and simplified uniform-speed reel. Take a look at it.

This reel is designed for simplicity and for complete control by the operator.

Air cylinders on the secondary arms control the pressure and uniformity of the winding roll on the reel drum face. The motor-operated primary arms provide easy transfer of the reel spool to the secondary arms.

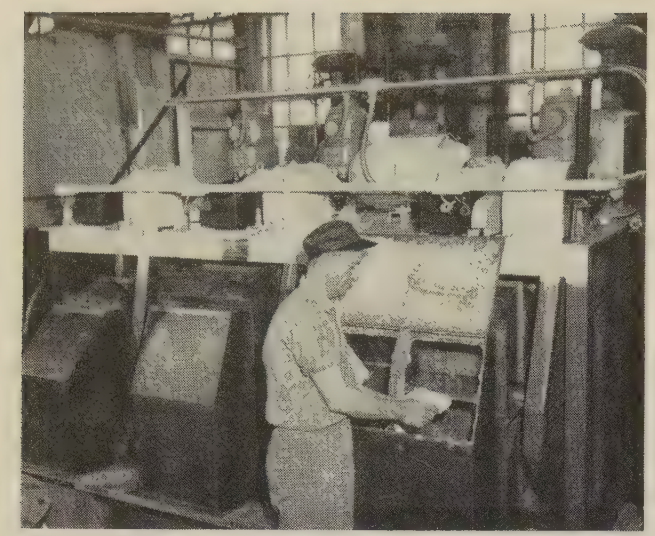
The Doctor is air-operated for quick in and out contact with reel drum to prevent sheet wrap of drum during reel changes.

It is definitely a push-button controlled reel and it can be built to wind rolls for any and all requirements.

For technical description, get in touch with the Black-Clawson Hamilton Division.

The Black-Clawson Co., Hamilton, Ohio

SHARTLE BROS. MACHINE CO., Middletown, Ohio • DILTS MACHINE WORKS, Fulton, New York
Northern Sales Office: 814 N. Superior St., Appleton, Wisc. • *Southern Sales Office:* 937 Coventry Road, Decatur, Georgia
Western Sales Office: Mayer Bldg., Portland, Oregon • *Associate:* THE ALEXANDER FLECK LIMITED, Ottawa, Ontario
Subsidiary: B-C INTERNATIONAL LTD., Greener House, 66/68 Haymarket, London, S. W. 1, England



Trimbey stock metering equipment has been installed ahead of both of the rebuilt paper machines at the Covington, Va., plant of West Virginia Pulp and Paper Co., replacing continuous mixers and thickeners which have been in operation for more than 25 years. Here William E. Lewis, beaterman, inspects hardwood pulp from one of the vats of No. 7 equipment

tial grade used in the manufacture of corrugated containers, was shifted to No. 7 machine, while the order pattern of the other five machines was altered to make up part of No. 7's production.

No. 6 machine was rebuilt in 11 days, renewing operations on February 28. After a shakedown the machine began producing a uniform, good quality board at the volume anticipated for initial operations. Then No. 7 was shut down. Work on this machine was completed in 13 days. It began its first trial run Sunday evening and is now producing an order of cup stock, experiencing only the difficulties usually encountered in a major rebuild of this type. Plant officials said it would be several months, however, before the two machines would reach top operating efficiency.

The "wet" ends of both machines were improved substantially by the installation of tile-lined stock chests equipped with constant agitation devices and new flow eveners and pressure-vacuum flowboxes, equipped with exacting controls to regulate the flow of pulp onto the machines wires. In addition, a modern new dual press was installed in the fourdrinier section of No. 7 machine, replacing two older single-press units.

The drying capacity of both machines was increased. A new hot air blowing system to reduce moisture content was installed in No. 6's drier section and four big steel drying cylinders, measuring 60 inches in diameter, were added, giving that machine a total of 50 paper driers. Six cylindrical driers of the same size and five additional felt driers were added to No. 7 machine, which now has a total of 43 paper driers and 10 felt driers.

A new and improved ventilating system was installed for both machines, which not only will improve their operating efficiency but will improve working conditions for the crew members, particularly during the hot Summer months.

The rewinding and roll finishing operations of both machines, previously carried out as a separate function, have been streamlined and relocated to provide straight-line operations directly behind the two machines. Rewinders from the finishing room were moved for that purpose. The area is equipped with new electrically driven overhead cranes to facilitate the handling of rolls from the reels of the machines to the rewinders.

The two rewinders were rebuilt and are equipped with a number of labor-saving devices which eliminate many time-consuming and laborious manual operations. Among the new devices on the machines are pneumatic slitters, pneumatic blowers which carry the roll trim directly to the broke beaters, mechanized shaft pullers, and removing gates and roll kickers which automatically move the heavy rolls from the rewinders onto the finishing tables.

One phase of the current paper mill improvement project not yet completed is the reactivation of the Nos. 6 and 7 cutting and sheet finishing operations, which were shut down in 1947. When this work is completed the new department will handle these operations for all machines and the equipment in No. 2 cutting and sheet finishing department will be dismantled to make room for installation of No. 8 paper machine.

List of Suppliers

Flow-eveners and pressure-vacuum flowboxes, Nos. 6 and 7 machines, Beloit Iron Works.
Paper and felt driers, Nos. 6 and 7 machines, Rice Barton Corp.
Ross-Grewin system, No. 6 machine, J. O. Ross Engineering Co.
Dual press, No. 7 machine, Rice Barton Corp.
Air-operated reel, No. 6 machine, Rice Barton Corp.
Nos. 6 and 7 rewinder rebuilds: Hydrair slitters, roll ejector mechanism, Cameron Machine Co.; shift pullers, Beloit Iron Works; trim handlers, J. O. Ross Engineering Corp.
Nos. 6 and 7 pulp proportioning systems, Trimbey Machine Co.; controls, Mason Neilan Regulator Co.
Tile lining for chests, Stebbins Engineering & Mfg. Co.
Propeller-type chest agitators, Improved Paper Machinery Corp.
Stock refiners, Sutherland Refiner Corp.

* * *

General Electric

The General Electric Co., Schenectady, N. Y., has issued a bulletin (G.E.A.-5678) on fractional horsepower gear motors.

John T. Bailey has been appointed Manager of G.E.'s newly formed Industry Control Dept.

* * *

Du Pont

G. L. Dorough has been named Manager of the peroxygen sales group in the sales division of Du Pont's Electrochemical Dept., Niagara Falls, N. Y.

Joseph Deinet, one of the leading vat dye experts, has retired from du Pont. He was one of the pioneer anthraquinone dye chemists. His work covered a period of 50 years.

* * *

D. J. Murray

A new barking drum that can be taken to the wood lot is now being manufactured by the D. J. Murray Mfg. Co., Wausau, Wis. It is called the Murco-Adams-Clark portable barker. A model made for the New York & Pennsylvania Co. handles 60-inch wood and weighs 21,800 pounds, less drive of 10,000 pounds. It is equipped with a Ford industrial gasoline engine, 50 hp., 6 cylinder.

* * *

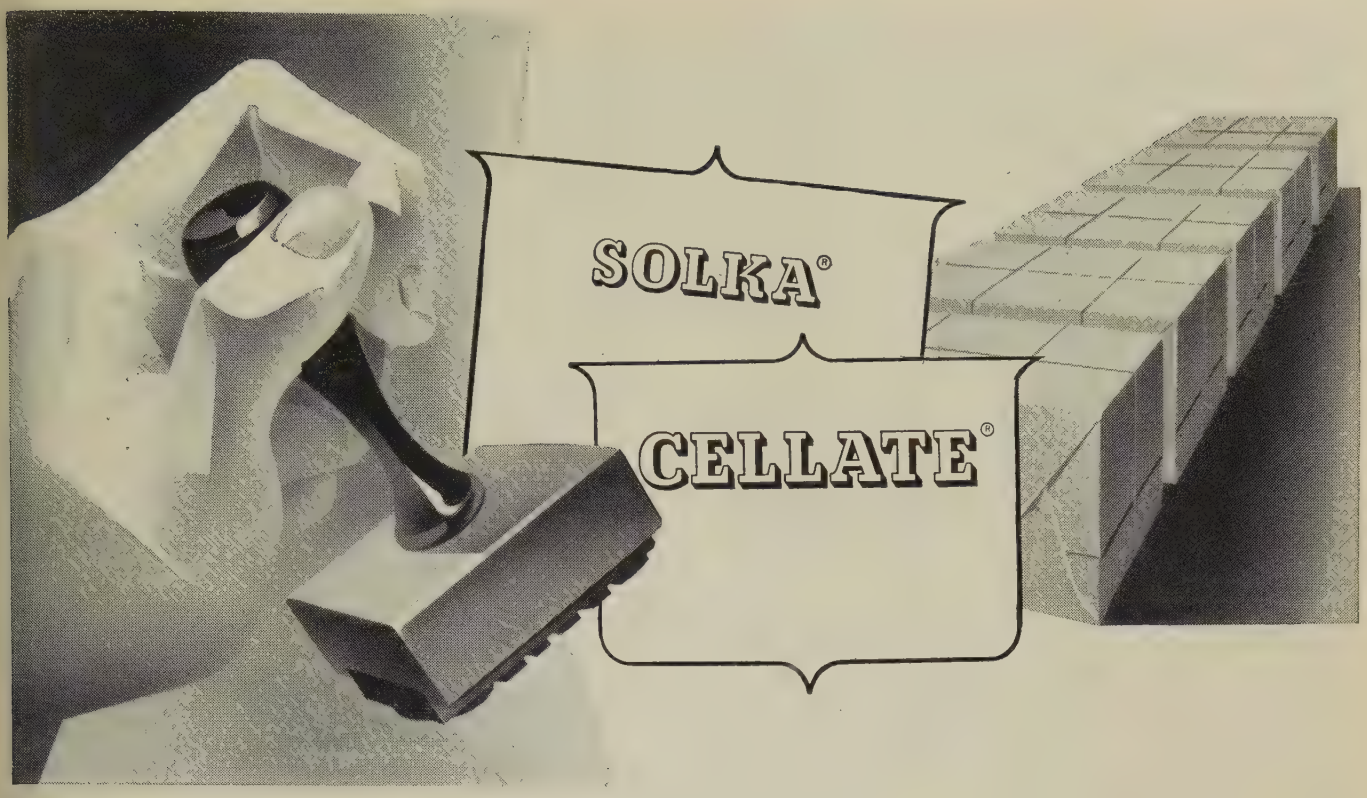
General Dyestuffs

The General Dyestuff Corp., 435 Hudson St., New York 14, N. Y., has issued a circular (AP-19) Paper White RB in the Paper Trade. This product is a direct dyestuff of the stilbene class which has the property of converting incidental ultraviolet light to visible light of high energy in the blue portion of the spectrum. The whiteness of paper is enhanced. It can also be used in paper coating.

* * *

J. M. Huber

The use of statistical quality control techniques was the theme of a talk given by Donald Macaulay, President, Paper Quality Control, Inc., before the sales organization of J. M. Huber Co., New York, N. Y. According to Mr. Macaulay, statistical quality control is a scientific technique for determining and controlling the multiple sources of production errors arising from the combined interaction of men, materials,



They Set the Standard for Quality

These seals are stamped on all Brown Company Solka and Cellate pulps. They are your assurance of the finest quality pulps manufactured from wood cellulose—pulps that set the standard for quality in the industry. Here's why:

Brown Company pulps are made principally from its own vast timberlands of northern softwood and hardwood. This assures quality control and a dependable source of raw material.

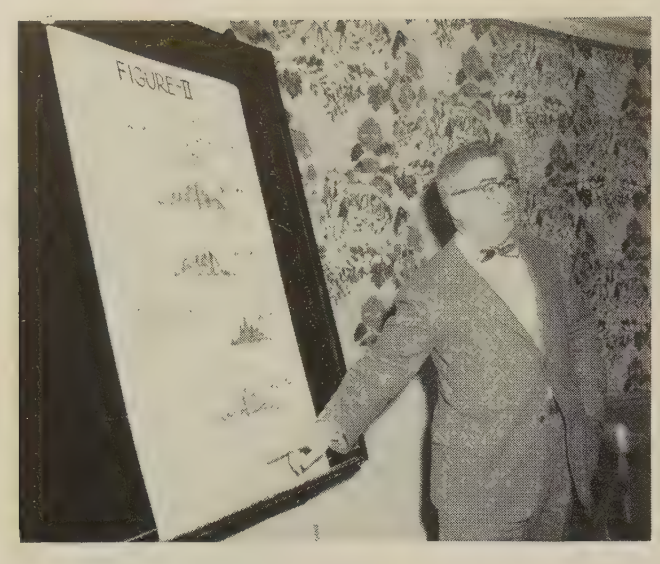
Brown Company research laboratories are constantly producing new fibres that enable the paper industry to take advantage of the versatile characteristics of wood cellulose. They were the first to make it economical and practical to use hardwood fibres in the manufacture of many products.

Our Technical Service Division is ready to work with you on any paper problem, however difficult it may be. Write Dept. DP-5. in our Boston office.

BROWN QUALITY COMPANY, Berlin, New Hampshire
CORPORATION, La Tuque, Quebec

General Sales Offices: 150 Causeway St., Boston 14, Mass.—Dominion Square Bldg., Montreal, Quebec

SOLKA & CELLATE PULPS • SOLKA-FLOC • NIBROC PAPERS • NIBROC TOWELS • NIBROC KOWTOWLS
ONCO INSOLES • CHEMICALS • BERMICO SEWER PIPE, CONDUIT & CORES



Donald Macaulay, President, Paper Quality Control, Inc., discusses statistical quality control techniques as "the progressive proof in printing production" before the Sales Executives Meeting of J. M. Huber Corp.'s Ink Division in New York City

and machines. He showed how statistics are being used in a printing plant for food labels, in a folding box plant, and in a national magazine.

* * *

Dow

H. W. Bull has been appointed Packaging Engineer for the Midland Div. of the Dow Chemical Co., Midland, Mich. The primary aim of this division is to standardize the packages and containers used by Dow.

The Plastics Dept. of Dow has issued a technical data bulletin on the use of Dow Latex 512K paper coating formulations on size press equipment.

Dow has issued a new loose-leaf folder describing its entire Dowicide line of germicides and fungicides.

* * *

Black-Clawson (Shartle and Dilts)

The Black-Clawson Co., Hamilton, Ohio, has announced the purchase of exclusive rights to manufacture and sell the new Moody automatic tail cutter. This device is applicable to any paper machine, and is particularly adaptable to higher speed, wide web tail cutting operations for quick reel starts. The inventor, E. L. Moody, is an experienced papermaker of Pensacola, Fla.

The Dilts Division of Black-Clawson, Fulton, N. Y., has issued two new bulletins on the Dilts Line of Converting Equipment and the "Kohler Systems Paper Reels and Super calenders (Bulls. 10DM and 7DM).

In February, Shartle Bros. Div. of B-C sold its 1000th Hydrapulper. This will be installed at the Piermont, N. Y., mill of Gair Cartons, Inc.

* * *

Infilco

Infilco, Inc., Box 5033 Tucson, Ariz., has issued a new bulletin (1845) describing its water treatment unit (the Accelator) for handling from 5 to 100 g.p.m.

* * *

Monsanto Chemical

A new series of water-soluble, modified polymer plastic resins for the paper industry has been announced by the Monsanto Chemical Co., Springfield, Mass. These are called the Lustrex X-700 resins and are suitable as tack promoters, film formers and viscosity builders for adhesives.

Remington-Rand

Remington-Rand, Inc., 315 Fourth Ave., New York 10, N. Y., has issued an interesting handbook "A Basic Plan for Record Retention and Destruction." They have also issued Bulletin F263 describing the Remington Rand Griscombe portable reader for reading 16 and 35-mm. microfilms.

* * *

International Nickel

The International Nickel Co., 67 Wall St., New York 5, N. Y., recently showed its new sound, color film, "Corrosion in Action," to a group of industrial journal editors in New York City. The film was made for technical, educational, and industrial groups. Organizations desiring to book this film for showings should write to the Corrosion Engineering Section of the company.

International Nickel has available reprints of the ASTM article "Atmospheric Durability of Steels Containing Nickel and Copper." Copies may be obtained from Dept. E.Z.

* * *

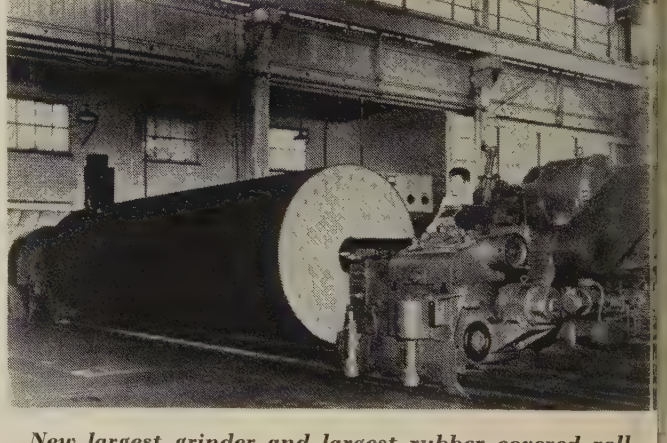
Eastwood-Neally

Harry G. Specht has retired as Vice-President and Director of the Eastwood-Neally Corp., Belleville, N. J., manufacturers of fourdrinier wires and suction box conditioners. Calvin H. Neally continues as President, John G. Mackechnie as Vice-President and Secretary-Treasurer, and Nelson W. Webb as Vice-President and Works Manager.

* * *

Raybestos-Manhattan

The Manhattan Rubber Div. of Raybestos-Manhattan, Inc., has installed a huge precision roll-grinding machine, the largest in the rubber industry at its roll-covering plant, North



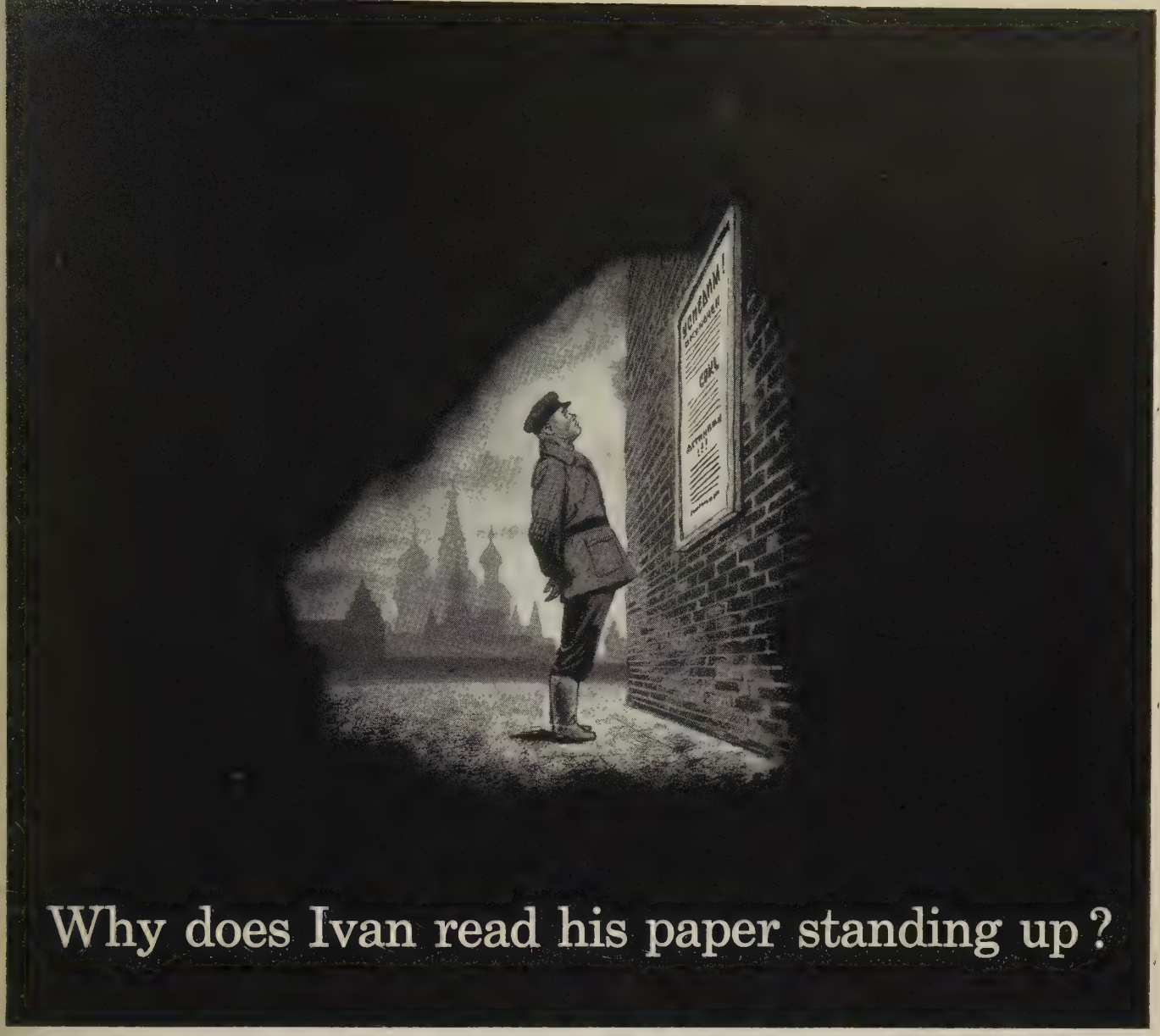
New largest grinder and largest rubber covered roll

Charleston, S. C. Just after installing it was used to grind the largest roll ever rubber covered in the United States, having a 240-inch face and a $60^1/_2$-inch finished diameter. The machine is 35 feet long between centers and will grind rolls from 10 to 62 inches in diameter and from a 50-inch face to 35 feet between centers.

* * *

Hooker

Hooker Electrochemical Co., Niagara Falls, N. Y., is sponsoring a research fellowship in chemical engineering at the University of Washington. The research will be concerned with uses of caustic soda and chlorine as related to the waste products of the pulp industry, such as lignin.



Why does Ivan read his paper standing up?

THIS is the way a Russian must read his newspaper, if he can read at all. That's because Russia does not produce enough newspapers to supply everyone who wants them.

Actually, Russia's per capita consumption of paper of all kinds is about 35 pounds a year. Here in our own country, each man, woman and child accounts for nearly 400 pounds of paper annually . . . more than 10 times the Russian consumption. Amazingly, American paper consumption has jumped 62% just since 1945!

Don't these figures suggest why America's educational level is so superior to that of Ivan and his compatriots? And doesn't that, in turn, pay tribute to the American paper and pulp industry, and its resourcefulness in meeting the tremendously increased demands for paper?

Pennsalt takes pride in being one of the many companies which supply this great industry with some of the chemical products it needs . . . chlorine, caustic soda, hydrogen peroxide, corrosion-resistant cements, and others.

PENNSYLVANIA SALT MANUFACTURING COMPANY

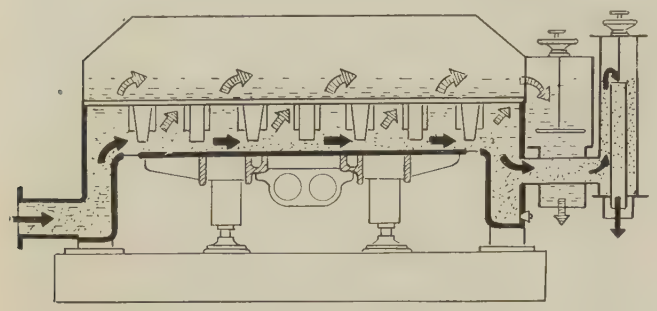
East: 1000 Widener Building, Philadelphia 7, Pennsylvania
West: 2901 Taylor Way, Tacoma 1, Washington

Pennsalt Chemicals

Progressive Chemistry for Over a Century

OLIVER UNITED

Oliver United Filters, Inc., Oakland, Calif., has recently acquired the Ahlfors upflow vibrating screen from Europe. This screen is suitable for primary and secondary screening of all types of bleached and unbleached pulps. Instead of a downward gravity flow of pulp the Oliver-Ahlfors screen operates with an upward flow. It is claimed to have high screening capacity. The knots, dirt, etc., drop down and away from the slotted screening surface and it can operate at much higher pulp consistencies than normal flat screens.



Drawing showing flow through the Oliver-Ahlfors screen

Oliver is consolidating and centralizing its departmental organization at the home office in Oakland, Calif. Ward H. Pitkin, Assistant General Sales Manager, and Carlton W. Crumb, Sales Promotion Manager, have transferred from New York City to Oakland.

Ward Pitkin, Oliver United Filters Inc.

C. W. Crumb, Oliver United Filters Inc.

* * *

HERCULES

Elmer F. Hinner, General Manager of the Virginia Cellulose Dept. and Paul Mayfield, General Manager of the Naval Stores Dept. of the Hercules Powder Co. have been elected Directors of the company.

* * *

WESTINGHOUSE

The following letter by George Snodgrass, Tester for ten years in the Switchgear Div. of the Westinghouse Electric Co., East Pittsburgh, Pa., was published by the Union Generator, a newspaper published by Local 601 of the International Electrical and Machine Workers, CIO, as a letter to the Editor:

Editor, *The Union Generator*
99 Braddock Ave., Turtle Creek, Pa.

In a recent issue of *The Union Generator* you invited readers to contribute questions for a column called "Gota a Beef?"

My question is: Why can't the Union and the People who are in the Union deal in a Christian manner with management?

It seems to me that there is more to be gained by cooperating in every possible way to try to increase the company's profit rather than to drag our feet and cuss the company for making a profit by the sweat of our brows.

The days of the coal and iron police are over and I don't think management or even the stockholders would want to go back to these methods even if it were possible. But even if it were, the purpose of our working here is to make a profit. It is our duty in all honesty to give a fair day's work for a day's pay.

The employee has a stake in the company even if he does not own a single share of stock. He has a job that represents an investment of from five thousand dollars upward. He doesn't own the job, because someone else invested the money to make the job for him. The amount of money the employee makes at the job will depend on how much money he makes for the investor. It's as simple as that. If he does not produce, it is economically impossible for him to make more money, and no amount of grievances or strikes can change it, and the employee loses his stake in the job.

Reform begins with self. If we do not deal fairly with the company, we cannot long expect them to deal fairly with us. I think that every man and woman who works should deal honestly and fairly with their employer, then if the employee does not get his just reward the Union has something definite to work on when they take the case to management.

The Union should deal fairly with management. If the Union goes to management with trifles and no kind of case for the things they hope to gain, management will soon learn to turn a deaf ear to their plea, but if each plea is justified it should not be hard to get a hearing at any time.

I hope to see the time when employees and management both deal in the Christian manner with each other and with everybody. Why not give it a try?

GEORGE SNODGRASS

* * *

LINK-BELT

Robert C. Becherer has been elected President of Link-Belt Co., Chicago, Ill., succeeding George P. Torrence who is retiring. Mr. Torrence will continue as a Director.

* * *

RICH-ROTH

Rich-Roth Laboratories, East Hartford, Conn., has issued a bulletin on its new "Ultra-Viscoson" for continuous, automatic viscosity measurements using ultrasonics. The instrument is used for manufacturing and research in the paper, plastics, coatings, and other industries.

* * *

BIRD

Bird Machine Co., South Walpole, Mass., will soon announce the opening of a new sales office on the Pacific Coast at either Portland or San Francisco.

B. D. Warren, Bird Machine Co.

Sven Fahlgren, Bird Machine Co.

Blanchard D. Warren, Assistant Sales Manager, will be in charge and will be assisted by Sven Fahlgren who has been calling on West Coast mills for several years.

* * *

America's Finest Family Circle

The family circle formed by *Appleton Machine Company Products* has the well-earned title of "America's Finest." Since 1883, *Appleton Machines* have given superior service to the pulp and paper industry everywhere. Write today for complete information on *Appleton Machine Company Products.*

Sales Representatives
Castle and Overton, Inc., 630 Fifth Avenue
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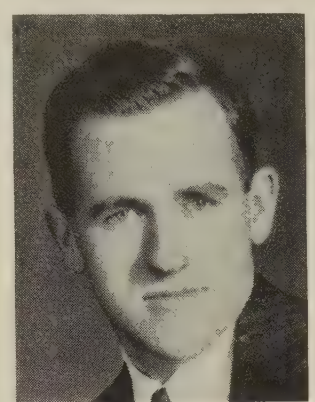
APPLETON MACHINE COMPANY
APPLETON WISCONSIN

CUSTOM-BUILDERS OF PULP & PAPER MILL MACHINES • WINDERS •
ROBERTS GRINDERS • FINISHING ROLLS • REWINDERS

BAUER BROS

J. A. LeVan has been appointed Sales Representative for Bauer Bros. Co. of Springfield, Ohio. His territory will cover Georgia, Alabama, Mississippi, Arkansas, Louisiana, and Texas. Mr. LeVan will reside at Springhill, Mobile, Ala. He was formerly with the Armstrong Cork Co. and the Celotex Co.

J. A. LeVan, Bauer Bros. Co.



David S. Williams, President, Graton & Knight Co.

* * *

GRATON & KNIGHT

David S. Williams has been elected President of Graton & Knight Co., Worcester, Mass., succeeding his father Arthur A. Williams who is Chairman of the Board. Graton & Knight is the largest manufacturer in the world of industrial leather products, including leather belting.

Alex Reikes has been appointed Manager of the San Francisco branch of Graton & Knight Co. manufacturers of leather belting. Mr. Reikes was formerly located at the head office in Worcester, Mass.

* * *

GLYCO

Glyco Products Co., 26 Court St., Brooklyn, N. Y., has issued a new bulletin on Synthetic Waxes for Use in Coatings.

* * *

HOLYOKE MACHINE

Holyoke Machine Co., Holyoke, Mass., recently elected the following directors: Archie Burack, Leon R. Cohen, Thomas E. Clark, Nathaniel M. Harvey, Edwin Farnum Greene, Irwin Sagalyn, and Julian L. Sagalyn.

Richard H. Dexter was named Sales Engineer for the Water Filtration Equipment Div.

* * *

I.T.E.

I.T.E. Circuit Breaker Co., Philadelphia, Pa., has issued Bulletin 5106 on Mechanical Rectifiers for Conversion Between 50 and 400 Volts D.C. These rectifiers are used in mills making their own chlorine for bleaching purposes. It has the advantage of high efficiency at low d.c. voltages making it economical to produce chlorine in smaller quantities than is normally done by large chemical companies.

* * *

BROWN INSTRUMENTS

The Brown Instruments Div. of Minneapolis-Honeywell Regulator Co., Station 40, Wayne & Windrim Aves., Philadelphia 44, Pa., has issued a useful 126-page booklet (80-2) on "The Fundamentals of Instrumentation for Industries." Other bulletins issued recently include Instrumentation Data Sheet (2.9-20b) "Uniform Strength Acid with Minimum Sulphur Consumption" and (2.9-11a) "White Water Temperature Control."

* * *

ANIMAL GLUE

The National Association of Glue Manufacturers, 55 W. 42nd St., New York 18, N. Y., has issued an interesting fabricoid-bound book (100 pages) on Animal Glue in Industry.

* * *

DE LAVAL

De Laval Steam Turbine Co., Trenton, N. J., has issued a 48-page bulletin (G-WWH) on Double Reduction Speed Reducers.

OBITUARY

Joseph Scheuermann

Joseph S. Scheuermann died on April 3, 1952. For the last two years he was Vice-President in Charge of the Converting Machinery Division, Bagley & Sewall Co., Watertown, N. Y.

Mr. Scheuermann was born in Scranton, Pa., on June 27, 1895. From 1914 to 1926 he was associated with R. Hoe Co. in New York City and from 1926 to 1950 he was Vice-President and Sales Manager of the Cameron Machine Co., Brooklyn, N. Y. He joined the Bagley & Sewall Co. in 1950 and resigned recently from that company.

He is survived by his wife, two sons, Robert and Richard, and two daughters, Lois and Mrs. Yvonne Vanderberg, of Kalamazoo, Mich.

Mr. Scheuermann was a member of the Technical Association of the Pulp and Paper Industry.

LETTERS TO THE EDITOR

Inspection of Pulp Digesters

Ed. Note: The following exchange of letters is published for the information of readers of *Tappi*.

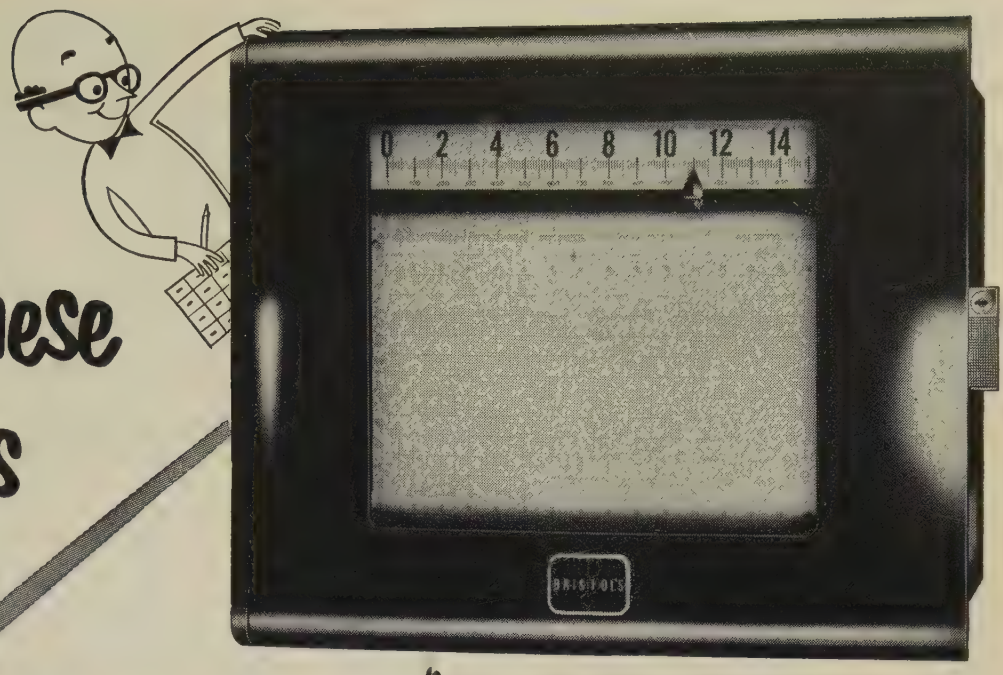
To the Editor, *Tappi:*

As new law regulations at present are drawn up for review of the pressure vessels, in which also cellulose digesters are included, we should be grateful to receive information of the corresponding regulations in the U. S. A. We are especially interested in the question how often the so-called inspection has to take place and at which time the inspection authorities demand the removal of the brick lining. Further, we should be interested in the regulations regarding the inspection of cover plates.

THE FINNISH PAPER ENGINEERS' ASSOCIATION

To the Editor, *Tappi:*

I am pleased to reply to your letter and note that pressure



Check these features OF THE BRISTOL DYNAMASTER FOR TEMPERATURE pH and SPEED

—the electronic master-mind for your measuring, recording and controlling problems

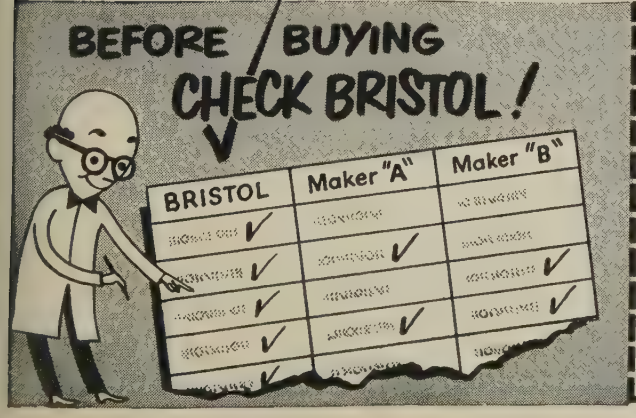
- ✓ Continuous-balancing electronic circuit responds instantly to minute changes
- ✓ All types of electric and air-operated controllers offered
- ✓ Available as a self-balancing bridge or potentiometer
- ✓ Trouble-free operation
- ✓ Electronic component uses vacuum tubes available at any radio supply house
- ✓ Full-scale pen travel in 7, 3 or ⅔ seconds
- ✓ Chart speeds from ¾ in. per hour to 7200 in. per hour
- ✓ Multiple recorders up to 16 points
- ✓ Components interchangeable and easily replaced on all Dynamaster models
- ✓ Immune to most vibration or shock
- ✓ Exceptionally unaffected by stray currents (1000 to 1 discrimination).

BRISTOL

FOR DETAILED PROOF *of the sensitivity, versatility and reliability of the electronic Dynamaster, use the coupon or write for Catalog P1245.*

The dependable Guidepost of Industry

AUTOMATIC CONTROLLING, RECORDING AND TELEMETERING INSTRUMENTS



THE BRISTOL COMPANY
102 Bristol Road
Waterbury 20, Conn.

Please send catalog giving details of Dynamaster performance to:

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

vessel regulations are being drawn up in Finland. With regards to the request for information on inspection of sulphite digesters, I wish it were possible for me to give you a complete, detailed reply. However, in this country, not too many of the states include digesters under their pressure vessel regulations. I think it will be to our mutual advantage to get further detailed information on this subject so I shall make a survey of the matter and have more complete information for you within the next several weeks.

At this time, it is our general practice to recommend complete relining of a sulphate digester every ten years if the lining looks at all questionable. Of course, there are cases where the lining is obviously intact and in good condition. Then, it is our feeling that common sense should prevail. We certainly would not expect the pulp mills to tear out a lining that has been well maintained and is in good condition.

Our inspectors view the lining as soon as the vapor has been cleared after a blow using an extension light suspended from the charging nozzle. If any dark, damp spots are observed on the internal surface of the lining, it is an indication of a "blow-back." Immediate investigation is necessary. The refractory in the affected area is removed until the extent of the liquor seepage has been determined. If it has penetrated the inner lining, all refractory is then removed in that area to determine the extent of any corrosive action on the shell plate.

H. M. Spring, Jr.
Chief Inspector, Boiler Division
Mutual Boiler and Machinery Insurance Co.
Boston, Mass.

To the Editor, *Tappi:*

This is in further regard to your recent letter to the Finnish Paper Engineers' Association letter and to my preliminary reply. I am pleased to attach replies received from my survey of a number of the chief inspectors of the different states. You will note that the State of Arkansas seems to be the only one that has a definite recommendation.

In my opinion this is carrying things just a little too far although one cannot be too careful regarding safety in digesters.

It is my opinion that the operators recognize the hazard and they should be instructed and trained to observe the condition of the refractory lining after each blow. This may be done by dropping in an extension light and looking for any dark spots that would be indicative of "blow-back." In other words, the liquor that might seep into a porous or defective area of the lining would blow back into the digester when the pressure is released to atmospheric. If such an area is found, it would then be very important to chip out the refractory to the full extent of liquor penetration. If it is found that the liquor has penetrated to the internal surfaces of the shell plate, refractory should then be removed over the affected area so that the extent of damage could be revealed and any necessary repairs could be made.

I feel that this viewing of the internal surfaces of the refractory should be done by a commissioned inspector at least once each year. As to the life or the lining, I believe at least the inner lining nearest the liquor be replaced once each ten years. At that time, the condition of the lining against the shell plate should be carefully examined and if it is found at all deteriorated, those portions, too, should be replaced.

Harry M. Spring, Jr.

Dear Mr. Spring:

I have for reply your letter in which you request information as to the departmental requirements for inspection of sulphite digesters.

The Boiler Division must be governed by the requirements of the Boiler Law, Act 451, Approved May 2, 1929, P.L. 1513 as Amended and Section 8 of that Law covers the frequency of inspection and states in part as follows: "Unfired pressure vessels shall be inspected as required by the rules and regulations of the department except that in no case shall regular inspections be required more than once in every twelve months."

Referring to your inquiry in the third paragraph of your letter concerning how often we require or recommend the replacement of the refractory lining. If you will refer to paragraph UE-3, page XXII of the requirements for existing installations, you will note: "Where in the opinion of the inspector, as the result of the conditions disclosed at the regular inspection, it is deemed advisable to remove interior or exterior lining covering or brick work to expose certain parts of the vessel not visible at time of regular inspection, the inspector shall require the removal of such material to permit of proper inspection and drilling of same to ascertain thickness if necessary." Under this paragraph the removal of the lining is left entirely to the judgment of the inspector. It is my understanding, however, that the inspector should not experience too much difficulty in determining whether the lining is in need of repair. Inspectors who regularly inspect sulphite digesters advise me the lining becomes discolored, mostly before there has been any harm done to the shell of the vessel. If that is true, then I believe the inspector could very easily determine when the refractory material should be removed to provide a complete inspection of the vessel and if it is found satisfactory, then the vessel can be relined.

Blaine M. Book
Commonwealth of Pennsylvania
Department of Labor and Industry

Dear Mr. Spring:

We have your letter with reference to sulphite digesters.

We have many such objects in this state and most of them are inspected by insurance company inspectors. Several of the refractory lined digesters have been replaced by stainless steel clad and stainless steel lined vessels manufactured by the A. O. Smith Corp. The refractory lined digesters have the shells drilled from the outside surface to about 75% of the wall thickness. Should a failure occur in the refractory which would permit the acid to come in contact with the inner surface of the plate the action of the acid would quickly destroy the wall of the vessel to such an extent that the tell-tale holes would indicate an internal failure of the refractory.

We have received several inspection reports from the insurance company inspectors which show that digesters have been seriously damaged by refractory failure, and in several cases new courses have replaced those damaged by acid. I cannot tell you the schedule set up by the insurance company inspectors for replacing the lining, however, I shall be glad to obtain this information and pass it on to you.

F. W. Smith, *Chief*
Boiler and Pressure Vessel Division
Bureau of Labor, Wage & Hour Commissioner
State of Oregon, Salem

Dear Mr. Spring:

Since receiving your letter with reference to sulphite digesters I have talked with R. J. Woodham, Chief Boiler Inspector for an insurance company, who has had considerable experience with such equipment. Mr. Woodham informs me that due to the ever-changing processes used in papermaking no time limit has been established for the safe operation of refractory lined digesters. All depends upon the process used and the care such lining receives. Mr. Woodham did state that the average life of refractory lined digesters appears to be about six years and in some instances one or two years longer.

The inspectors keep an ever watchful eye on the lining and in most cases the digester operators examine the face of the lining after each cook. If small cracks appear in the

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ANSWER:
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QUESTION:
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ANSWER:
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lining they immediately drill and tap a small hole in the shell in line with the crack or cracks and slowly pump or force in mortar which will partially fill the cracks and any cavities caused by the acid leaking through, thus decreasing the area in which the acid could take effect. In some cases the acid would penetrate the cracks and attack the metal and if allowed to continue the metal would be weakened to such an extent that a failure would occur.

It is my understanding that there are several types of refractory and mortar being used in digesters and that the manufacturers of such material are doing a great deal of research in the development of a refractory lining that will give a maximum of service. Of course a great deal of research work is being done in the development of metal lining.

F. W. Smith

Dear Mr. Spring:

Answering your inquiry regarding our rule regarding the removal of insulating material, etc., from boilers and pressure vessels for purpose of inspection will say that we have no statute law covering this but use as a rule the fourth paragraph of I-38 of the A.S.M.E. Boiler Code.

Harry S. Brunson, *Chief*
Division of Boiler Inspection
Department of Labor and Industry
Industrial Commission of Minnesota
St. Paul

Dear Mr. Spring:

We are in receipt of your letter requesting information regarding the requirements in this State covering the inspection of sulphite digesters.

Under the governing laws, we are required to check this type vessel internally once each year and remove portions of the refractory in different locations to determine the condition of the internal surface of the digester. If pitting or corrosion is noted in any one place, the defective refractory material is removed and renewed.

M. L. Blair, *Chief Inspector*
Department of Labor
State of Arkansas, Little Rock

Dear Mr. Spring:

We have no special requirements for inspection of sulphite digesters as the law makes no provisions for inspection of pressure vessels.

William H. Riley, *Labor Commissioner*
Department of Labor
State of New Hampshire, Concord

Dear Mr. Spring:

In reply to your letter, requesting information regarding the inspection of sulphite digesters, we have not had any experience with the digesters in the State of California as yet. Therefore, we are unable to answer the questions outlined in your letter.

A. H. Agaton, *Supervising*
Boiler Safety Engineer
Department of Industrial Relations
Division of Industrial Safety
State of California, Sacramento

Dear Mr. Spring:

I am afraid that I will be unable to give you any helpful information on your question pertaining to the inspection of sulphite digesters.

As you realize, such objects do not come under the jurisdiction of this Department and my insurance experience included only an occasional inspection of digesters.

As I remember my insurance requirements, there was a definite time period given to recommend the replacements of the linings. Whenever, upon inspection, a section of the lining was found to have cracked or otherwise deteriorated the immediate section of the defect was removed for an examination of the plate. Of course in such a case, if evidence of corrosive action was found, an additional amount or all of the lining would be removed depending on the conditions indicated.

H. G. Cutter, *Chief Inspector of Boilers*
Department of Labor and Industry
State of Maine, Augusta

Dear Mr. Spring:

Thank you for your letter, requesting information on the type of linings used in sulphite digesters.

The State of Delaware at the present time has no unfired pressure vessel legislation, nor mandatory rules and regulations on construction, inspection, and operation of unfired pressure vessels, and my personal experience in regard to sulphite digesters is somewhat limited; however, one or two of our Board members may be in a better position to furnish the information you require and I am taking the liberty to refer your inquiry to them.

Henry S. Mauk, *Chief Inspector*
Board of Boiler Rules
State of Delawore, Dover

Dear Mr. Spring:

I have your inquiry regarding the inspection of sulphite digesters. The State Boiler Law does not cover, at the present time, unfired pressure vessels, and I am not sure that this type of vessel comes within the provisions of the State Law.

I fully agree with you that leakage of the joints would be serious if allowed to continue. But, unless these vessels are classified as boilers, our law would not cover them. If you have some specific case in mind, we would be glad to cooperate with you in setting up a suitable inspection frequency.

Lynn C. Peal, *Chief Inspector*
Boiler & Elevator Inspection Div.
Department of Labor
State of Tennessee, Nashville

Dear Mr. Spring:

The Present Boiler Law of Michigan does not include unfired pressure vessels, therefore, this department makes no specific requirements or recommendations regarding inspections of unfired vessels such as the sulphite digesters you mention in your letter.

This department does, however, have jurisdiction over the use of unsafe equipment, and as the A.S.M.E. Code symbol on a vessel is the guarantee that the vessel is of an approved design, constructed to code, and shop inspected by an authorized inspector, we recommend that all pressure vessels be A.S.M.E. construction.

Royal Beckwith, *State Boiler Inspector*
Department of Labor
State of Michigan, Lansing

Dear Mr. Spring:

We do not have any specific requirements relative to the replacement of refractory lining.

From my viewpoint, this would all depend upon the quality of the lining, the type of service it would have to stand up under and which would only be determined by stated periods of inspection in accordance with good practice and as set forth in the A.S.M.E. Code.

The thickness of the metal should be increased to take care of corrosion damage which of course you are acquainted with.

Joseph F. Scott, *Deputy Director*
Department of Labor and Industry
State of New Jersey, Trenton

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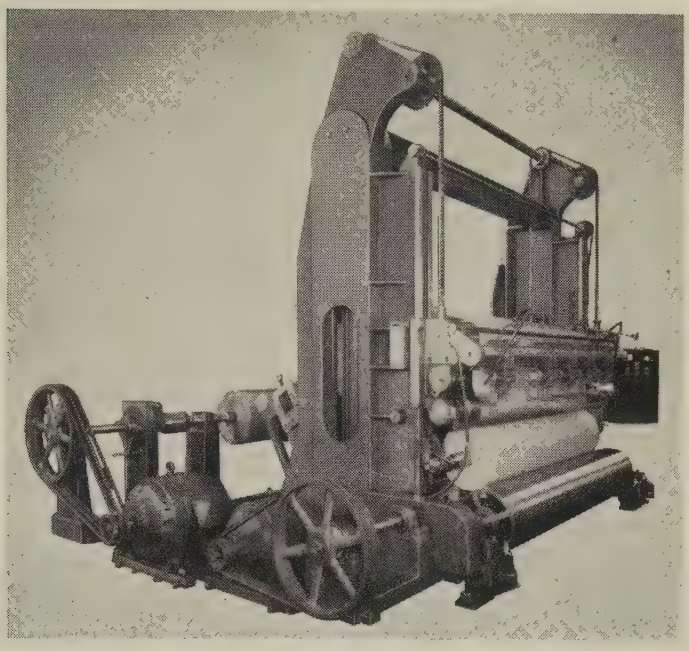

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TAPPI DIVISIONS AND COMMITTEES

Recent Reports of Activities

Acid Pulping Committee

The annual meeting of the Acid Pulping Committee was held on Feb. 18, 1952, at the Hotel Commodore in New York City. E. O. Ericsson and J. M. McEwen were present from the West Coast group. N. L. Malcove and J. N. McGovern represented the Lake States Subcommittee, while O. E. Anderson, T. Gerace, and F. J. McCourt were present from the Eastern Subcommittee. In addition to the committee members, the following people contributed to the discussion:

L. C. H. Beighey, Hammermill Paper Co., Erie, Pa.
N. W. Coster, Scott Paper Co., Everett, Wash.
J. C. Cousins, Penobscot Chemical Fibre Co., Great Works, Me.
K. O. Elderkin, Crossett Paper Mills, Crossett, Ark.
S. E. Hazelquist, Weyerhaeuser Pulp Div., Longview, Wash.
L. G. Stockman, Swedish Forest Products Research Laboratory, Stockholm, Sweden
Jack Wilcox, ESCO, Portland, Ore.

Activities of the past year reported included the sponsorship of TAPPI research project 28, "Thermodynamic Properties of Ammonium and Magnesium Bisulfite Solutions." This project is being conducted by a graduate student at the University of Washington working under the direction of J. L. McCarthy. The preliminary library work has been completed and laboratory work about to start. The committee also sponsored a survey of strainers and circulation in sulphite mills. Results of this survey were reported at the Acid Pulping Session on February 19. The West Coast group sponsored a section meeting on sulphur saving last Fall.

Certain proposed projects were discussed. These included:

(*a*) A research grant for the production of food yeast from ammonium base sulphite liquor. Not recommended, because it was thought the information would closely parallel that gained and made available by the Wisconsin Manufacturer's Group which started the yeast plant at Rhinelander.

(*b*) A research grant for a study of the products of combustion of soda and ammonia base waste. Not recommended at this time since the Crown Zellerbach-Scott pilot plant investigations intend to publish their results on this subject and it is understood the Cottrell precipitation people intend to publish information on the products of combustion of soda base liquor. This project may be reconsidered later if these investigations prove insufficient.

(c) Sponsorship of a questionnaire on sulphur consumption was discussed and rejected because the Canadians have done a fine job with this subject in their published reports. It was felt further work would have to be in such detail that the special conditions at each plant would make the information of little use for general application.

(d) The Babcock and Wilcox method of measuring the solids content of waste liquor was discussed. The committee voted to recommend to the Nonfibrous Materials Testing Committee that the liquor solids test outlined in T 629 m-48 was unsatisfactory and a better and more reproducible test, possibly the B & W one, be adopted.

(e) The committee discussed 0 406 p-49 "Standard Terms Used in the Sulphite Pulping Process." This should have been filed in the Acid Pulping section as 0-300. The group recommended that it be renumbered. No revisions were suggested.

(f) A recent paper by Lennart Stockman of the Swedish Forest Products Research Laboratory indicates that formic acid formed in cooking influences the stability of cooking acid. This may be of special interest to the mills re-using cooking liquor in accumulators or using it for dilution in the digester when the liquor is to be evaporated. Items to be considered include effect of wood species, type of base, and methods of determination of formic acid. Mr. Stockman was visiting this country and was at the meeting so he was able to aid greatly in the discussion. The committee decided to have the West Coast group review the problem and to request a TAPPI research grant if further study showed the project to be of value.

(g) Tests to determine the per cent combined late in the cook were discussed. It was agreed that the regular methods such as T 604, RC-143, and RC-144 were unsatisfactory in highly colored solutions. One mill has had some success in determining the combined in colored solutions by a potentiometric titration with sodium hydroxide to pH 5. This method agrees with the Palmrose test (RC-143) if the liquor is light enough to see the end point. The group voted to recommend to the Nonfibrous Materials Testing Committee that they consider this test for colored sulphite solutions.

(h) The group discussed the effect of soluble bases on materials of construction. After some discussion it was decided to contact the mills using soluble bases to present papers on their corrosion problems or conduct a round table on this at a TAPPI meeting.

(i) Jack Wilcox presented the results of a survey he had made on heater tube corrosion in sulphite mills on calcium base. The committee decided to have the West Coast group work with Mr. Wilcox in extending the survey and publishing the results.

The annual Acid Pulping program was held Feb. 19, 1952 at the Hotel Commodore in New York City. The room seating about 200 was filled to capacity throughout most of the program. The following papers were presented:

1. "Pilot Plant Recovery of Heat and Sulphur from Spent Ammonia-Base Sulphite Pulping Liquor," by J. H. Hull, Crown Zellerbach Corp., Camas, Wash., and G. V. Palmrose, Soundview Div., Scott Paper Co., Everett, Wash.
2. "Acid Pulping Committee Report on TAPPI Strainer and Circulation Survey," by John M. McEwen, Pulp Div., Weyerhaeuser Timber Co., Everett, Wash.
3. "Sulphate Formation and Its Effects on Sulphur Usage," by George McKnight and M. S. Anderson, Oxford Paper Co., Rumford, Me.
4. "Magnesia-Base Recovery for the Sulphite Pulping Industry," by Svarre Hazelquist, Pulp Div., Weyerhaeuser Timber Co., Longview, Wash., and Charles E. Rogers, Babcock & Wilcox Co., Alliance, Ohio.
5. "Modern Developments in Welded Barking Drum Design," by George M. Dick, Canadian Ingersoll-Rand Co., Sherbrooke, Que.

JOHN M. MCEWEN, *Chairman*

Mechanical Pulping Committee

The meeting of the Mechanical Pulping Committee was called to order at 2:30 p.m. by the chairman. Among those present were: W. H. de Montmorency, E. H. Johnson, Donald Hunter, representing Mr. Pingrey, J. L. Parsons, representing T. Kloss, John Boymiller, Armstrong Cork Co., Lancaster, Pa., and R. L. Leaf, Jr., Little Rapids Pulp Co., Wes DePere, Wis.

A brief discussion of the groundwood survey data sheet compiled during the last year was carried out and copies of this will be sent to each of the members for compilation of data according to this form, from the previous groundwood question

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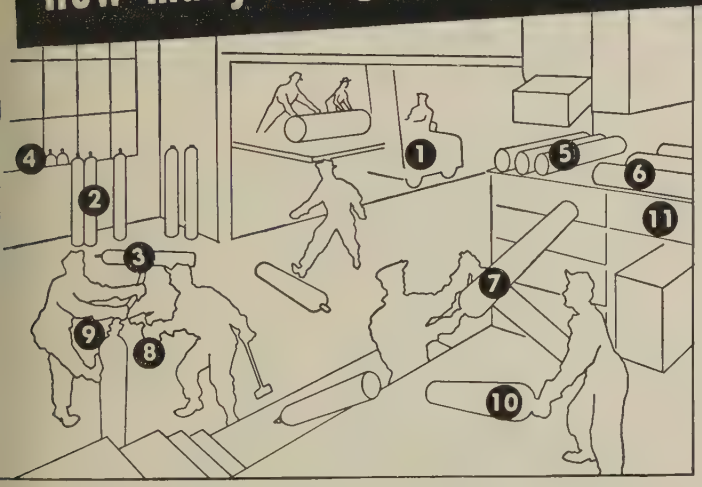

Answer drawing

1 Special hoists required for ton containers.
2 Cylinders must be stored away from steam pipes or other heat.
3 Empty cylinders need valve protective caps.
4 Both empty and full containers must have valve bonnets on.
5 Cylinders must be stored upright.
6 Do not store chlorine near ventilating systems.
7 Cylinders must not be dropped.
8 Do not apply heat to valves.
9 Never use a pipe wrench.
10 Do not lift cylinders by valve protective caps.
11 Do not store containers near flammable materials.

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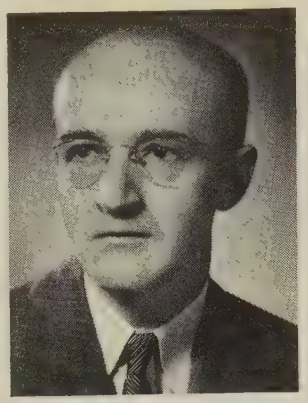
naire. Subsequent data sheets covering wood handling and debarking, screen riffling, and utilization of screen rejects are to be prepared.

James Perry of the Norton Co. was appointed to serve as Secretary to the Mechanical Pulping Committee. The meeting was adjourned at 3:45 so that members of this committee could sit in on the Semichemical Subcommittee meeting.

John M. McEwen, Weyerhaeuser Timber Co., Chairman, Acid Pulping Committee



F. W. O'Neil, College of Forestry, State University of New York, Chairman, Mechanical Pulping Committee

A lively discussion pertaining to semichemical pulping was held in the same room and it was decided that the semichemical group should form its own commitee. The report of this committee will be submitted by its Chairman, John McGovern.

F. W. O'Neil, *Chairman*
Mechanical Pulping Committee

Preparation of Papermaking Materials Committee

The Preparation of Papermaking Materials Committee met on Feb. 18, 1952, and considered the following projects.

Filler Monograph. Although this project was assumed complete at the February, 1951, meeting it was discovered that two items had not yet been finished. J. F. Theriault has taken over the completion of this project and will contact individuals to write up the two remaining items.

Significance of Sizing Tests. The first questionnaire on sizing tests which was sent to the field service men of rosin sizing suppliers has been completed and was distributed to the committee members during the Winter. The results of this questionnaire will be summarized by the Chairman for publication.

After considerable discussion it was decided to select the three most commonly used tests for three types of paper, draw up a questionnaire concerning the tests, and send it along with a set of 4 or 5 samples of varying sizing qualities to several technical men in mills manufacturing this type of paper. The purpose of this will be to check on the reproducibility of test results and to see if there is a common agreement as to the point of acceptability of the paper as far as sizing values are concerned.

Because of the wide variations in end use and the "tailor-made" aspects of most sizing tests now in use in coarse papers, it was decided to try only a few types in this second-stage questionnaire to see if it is possible to draw general conclusion by this method. It appeared to be the general consensus that most mills had reached their standards for each large customer by a gradual "feeling out" process and that the general results do not lend themselves to easy classification or standardization.

It is expected that a committee meeting will be held at the annual Spring meeting of the New England Section in May 1952.

The following now constitute the membership of the Preparation of Papermaking Materials Committee:

F. S. Klein, *Chairman*, Byron Weston Co., Dalton, Mass.
J. P. Bainbridge, *Secretary*, Monsanto Chemical Co., Everett Mass.
John McWilliams, Byron Weston Co., Dalton, Mass.
R. G. Mispley, Crown Zellerbach Corp., Camas, Wash.
L. A. Moss, Whiting-Plover Paper Co., Stevens Point, Wis.
R. J. Proctor, West Jersey Paper Mfg. Co., Camden, N. J.
L. H. Peterson, Rising Paper Co., Housatonic, Mass.
Wm. H. Roberson, Hercules Powder Co., Wilmington, Del.
F. L. Simons, Crane & Co., Dalton, Mass.
E. W. Strecker, Esleek Mfg. Co., Turners Falls, Mass.
F. J. Theriault, Robert Gan Co., Uncasville, Conn.

Significance of Sizing Tests Subcommittee

Fine Papers:	*Coarse Papers:*
L. A. Moss, *Chairman*	R. G. Mispley, *Chairman*
F. L. Simons	R. J. Proctor
W. E. Strecker	F. J. Theriault

Material Preparation Methods Subcommittee

J. P. Bainbridge	L. A. Moss
F. S. Klein	J. F. Theriault

Filler Monograph Subcommittee

R. J. Proctor	J. F. Theriault

Water Committee

The Water Committee meeting was held in the Gran Ballroom of the Hotel Commodore at 2 p.m. on Monda February 18, with the following present:

A. S. Erspamer, *Chairman*, P. H. Glatfelter Co.
C. L. Anderson, Hammermill Paper Co.
F. W. Bishop, Southland Paper Mills
C. M. Connor, W. C. Hamilton & Sons
R. B. Martin, Wallace & Tiernan Co.
E. N. Poor, Hudson Pulp & Paper Co.
J. J. Priest, Halifax Paper Co.
W. A. Tanzola, W. H. & L. D. Betz Co.
A. M. Thurn, Champion Paper & Fibre Co.
J. F. Baigas, Jr., Natl. Council for Stream Improvement
S. W. Bergen, Conservation Foundation
J. A. Holmes, National Aluminate Corp.
F. H. Klaer, Ranney Method Water Suppliers, Inc.
O. D. Mussey, U. S. Geological Survey
E. S. Nordell, Permutit Co.
E. H. Sieveka, U. S. Geological Survey
J. N. Stephenson, Joint Textbook Committee

The first subject taken up was the possibility of a cooper tive questionnaire with participation by the Water Con mittee and Conservation Foundation. Stephen Bergen the Conservation Foundation explained the purpose of such survey. The Conservation Foundation is interested in aidi water conservation in industry by developing useful infc mation on industrial water need and practices. In 19 the Foundation, jointly with the National Association Manufacturers, published "Water in Industry," which giv the results of a questionnaire survey of water use in 33 plants from among NAM members. The questionna sent out was general in scope, as it had to apply to 15 bro industrial groupings, rather arbitrarily distinguished purposes of analysis.

As the summary of the findings was prepared, it was cl that data from the questionnaire on water use per unit product were of limited value taken by themselves. Th revealed considerable ranges in water use within each dustry; but except for data on total re-use of water with certain plants, there was no way to account for differenc from plant to plant, in the quantities of water used per u of product. The reasons for these quantity ranges may guessed. Plants with an abundant supply probably will r re-use water. Some plants manufacture their own power a therefore have greater total requirements. And recirculati

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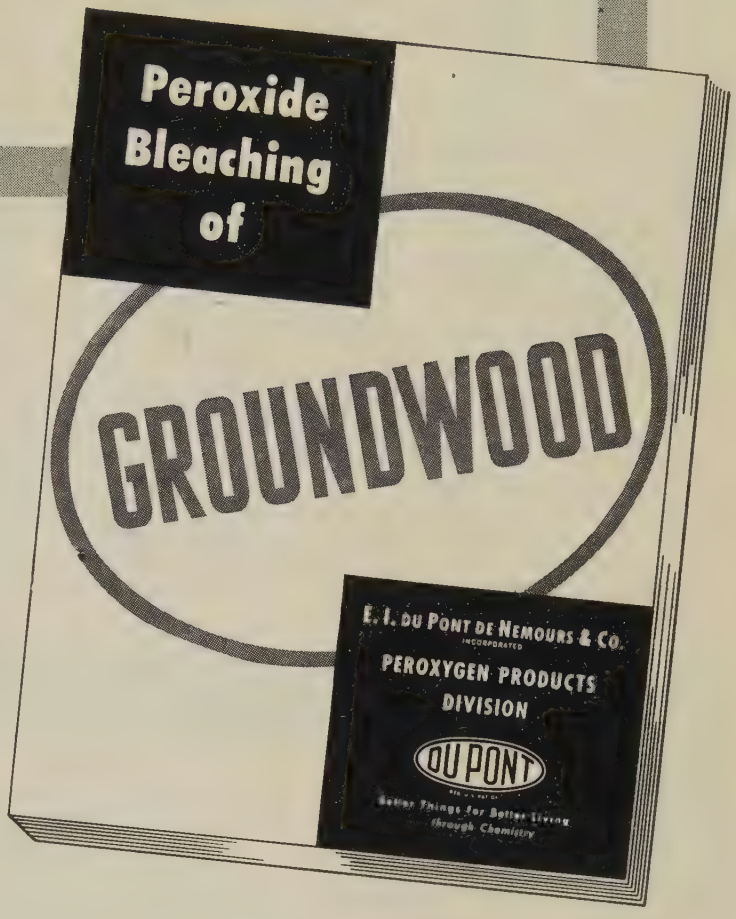

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of water may be feasible and economical when a plant has facilities to obtain process water of a certain quality, or to treat wastes before disposal.

These ranges in quantities of water used indicate that, where necessary, it is often possible for manufacturing plants to conserve water and thus reduce their demand on local water sources. Apparently such water economy sometimes may also result in lower operating costs. Developing and making available information on water use within each industry would therefore seem to be one way of assisting industry to meet its increasing water needs.

It was agreed that useful information could be obtained in the questionnaire. Copies of Mr. Bergen's outline were distributed and the various committee members agreed to study it and submit their suggestions in the near future. The Chairman in turn would coordinate the various suggestions and outline the questionnaire.

Mr. Stephenson of the Joint Textile Committee discussed the status of Volume IV, particularly with reference to the chapter on Water. Mr. Tanzola and Mr. Holmes offered to help out on several of the unassigned portions of the chapter and the Chairman volunteered to contact Dr. Gehm of the National Council in relation to the section on waste effluents.

Arthur Thurn then discussed the summary of the questionnaire on analytical testing methods. The questionnaire was quite favorably received as indicated by the 51% response. The summary will be forwarded to the participating members and will be published in a future issue of *Tappi*.

A suggestion from one of the Water Committee members was discussed. This member pointed out the difficulty in obtaining papers for the Annual Meeting from mill members of TAPPI. He felt that this was due to reluctance on the part of mill management. His experience has been that mills do not contribute and it is necessary to fall back on equipment suppliers for the greater part of the papers.

Mr. Holmes commented on this and offered his experienc along these lines as a suggestion. He cited a technic organization which became so overrun by suppliers papers such a purely sales nature that the organization practicall folded up. They tried to eliminate papers by suppliers bu this was almost as bad in that it was not possible to get enoug papers to fill the program. An industry committee wa formed and it was put up to the suppliers not only to furnis papers of a high quality, but also to recommend persons n connected with sales who could present suitable papers. Th suppliers are in a good position to do this because they a calling on many plants and make wide contacts. In som cases the suppliers have helped the individuals to write paper but have made sure that any sales propaganda was eliminate or held to a minimum.

Another feature was to have several suppliers on the com mittee, elected not only on the reputation of the company, bu also of the individual. These individuals are selected not s much as a representative of some particular company, bu more as a representative of all suppliers. It is then up t those selected to sell their competitors that they are workin for the suppliers in general and not for any particular com pany. This suggestion was well received and will be give serious consideration in planning future programs.

A. S. Erspamer, *Chairman*

Graphic Arts Committee Meeting

The Graphic Arts Committee of TAPPI met at the Commo dore Hotel at 2:00 p.m. on February 18 with the followi men present:

E. R. Duffie, Sun Chemical Corp.
A. L. Ensink, A. B. Dick Co., Chicago
Robert Simmons, G.P.O.
Dr. George Sears, Institute of Paper Chemistry

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H. W. Verseput, Robert Gair Co.
A. K. Staman, Curtis Publishing Co.
Charles Morton, West Virginia Paper & Pulp
Jay Tappen, Mead Corp.
W. R. Willets, Titanium Pigment Corp.
Fred Elliott, *Chairman*, Time-Life, Inc.
H. M. Annis, Secretary, Oxford Paper Co.
M. S. Kantrowitz, Government Printing Office

Mr. Annis of the Oxford Paper Co., New York, was appointed Secretary of the Committee.

Mr. Burnett of the Ohio Boxboard Co. was introduced as the new General Chairman of the Converting Committees and briefly outlined the organization setup. He also outlined the procedure in getting TAPPI research appropriations.

The Committee discussed a Fall meeting with the general plan to be a round-table meeting. The initial planning for this meeting is in the hands of Mr. Elliott, Keith Gainer, and Mr. Annis and the committee were requested to submit ideas. The general idea would be to have the Fall meeting in the New York area.

The publishing of a monograph on printability was discussed. The Chicago group have done some work on this problem and there was some question as to whether the approach was the proper one for a technical presentation on this subject.

Dr. Sears suggested a paragraph from time to time in *Tappi* to keep those interested posted on Graphic Arts Committee Meetings, together with a brief summary of what happened in such meetings.

The discussion brought out the need of better communications between the papermakers and the printers. It was suggested that an annual report be considered covering improvements and changes in requirements during the previous year. Mr. Morton has some definite ideas along these lines and will send an outline to the writer.

There was considerable discussion on the subject of printing smoothness and it was felt that it would be a good subject for consideration for the Fall meeting.

HAROLD M. ANNIS, *Secretary*

Coating Committee

The meeting of the Coating Committee was called to order by J. H. Heuer, Chairman, who announced that the responsibility for the Raw Stock Monograph had been transferred from Dick Trelfa to John Donohue of Hercules Powder Co.

A. S. Erspamer, P. H. Glatfelter Co., Chairman, Water Committee

F. D. Elliott, Time-Life Inc., Chairman, Graphic Arts Committee

Jack Wilbur was then asked to report on his progress in lining up various possibilities of a research project for im-

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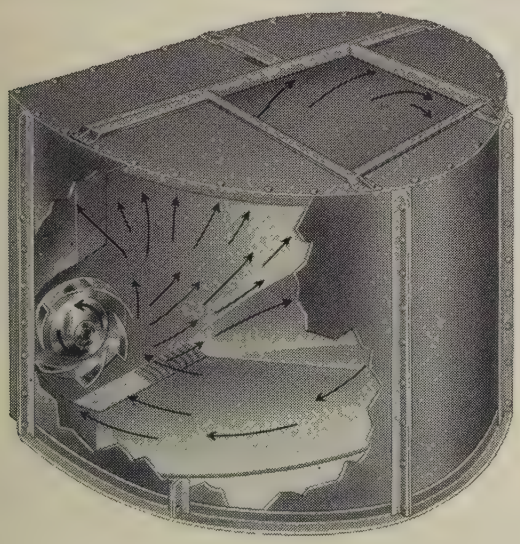

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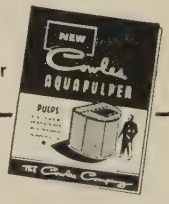

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proving the high shear viscometer. After a great deal of correspondence with men in the field, a tentative program was made outlining a suggested program which was presented at the October Coating Committee meeting. Only two returns were received to the questionnaire. This was disappointing since it is difficult to formulate a plan of action which might meet with general approval. It has been suggested to start studying the instruments—there are six or seven possible choices. There is the question of correlation between performance of an instrument and the actual performance of a coating color in the mill.

Someone suggested that the committee should get down to studying fundamental theory—e.g., Maxwell's laws on relaxation, flow properties, in existing viscometers we may have the reciprocal of flow—not the resistance to flow. It was suggested that the man selected to do this research job should be invited into the coating committee meeting after he has had a chance to get started. Several expressed the opinion that the first step was to get the ring instrument to study.

Several estimates were made as to cost. Ten thousand dollars a year was suggested if the research organization did not include overhead. A report was requested on the various contacts to be ready for consideration at the Chicago committee meeting so that a real start could be made on this project.

Mr. Thompson of Calgon reported on the progress on the monograph dealing with color preparation. Seven chapters have already been lined up, and others have been tentatively promised. This monograph should be ready within the next year.

Mr. Bingham reported that the Protein and Adhesives Monograph is in page proof and has been sent to the authors for final reading. The Monographs on Testing Methods, Wax and Gummed Papers will have to wait till later.

The following attended this committee meeting:

J. H. Heuer, Great Northern Paper Co.
Fred H. Denham, R. T. Vanderbilt Co.
Nat. Frisch, Stein-Hall & Co.
Jack E. Wilber, St. Regis Paper Co.
Kenneth M. Gaver, The Keever Starch Co.
Edward J. Heiser, Dow Chemical Co.
John E. Donohue, Hercules Powder Co.
Lester J. Beaulieu, Sherman Paper Products Co.
Frank W. Egan, Frank W. Egan & Co.
Robert F. Reed, Lithographic Technical Foundation
Gordon C. Wheeler, Lithographic Technical Foundation
Leo Lake, Kalamazoo Vegetable Parchment Co.
Leonard Swec, H. P. Smith Paper Co.
G. I. Hoover, Provincial Paper Ltd.
Don A. Hughes, R. T. Vanderbilt Co.
C. T. Fogarty, Stein-Hall & Co., Inc.
R. N. Thompson, Calgon, Inc.
N. R. Gotthoffer, Buckeye Cotton Oil Co.
W. M. Bain, The Glidden Co.
R. O. Brabon, Reichhold Chemical Co.
Ralph E. Carter, Reichhold Chemical Co.
Albert G. Buck, Reichhold Chemicals, Inc.
D. W. McArthur, Reichhold Chemicals, Inc.
Vance Vallandigham, Kelco Co.
J. Bullard, Corn Products
Werner Kaufmann
W. R. Willets, Titanium Pigments
Lois V. Hans, Army Research & Del. Q.M.C.

Container Testing Committee

The Container Testing Committee met on Feb. 20, 1952, in Room F at the Hotel Commodore, New York City.

It isn't often that a committee meeting can proceed from the moment it is called to order until it is adjourned by following a prepared agenda from beginning to end, however, this was done in this meeting.

Charlie Krebs, unfortunately, was called home the night

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before the meeting was called; therefore, Earl Stivers acted as temporary Chairman.

By vote of those present, Charles Krebs was elected Chairman for the year 1952–53. C. S. Macnair was elected Secretary.

No additional appointments were made to the Advisory Board as none seemed necessary.

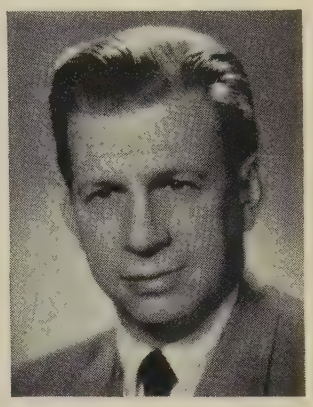
A report was made by H. D. Scordas on test methods for manufacturer's joints. The selection of H. D. Scordas as Chairman of a subcommittee to develop "Test Methods for Manufacturer's Joints" was confirmed by the committee. His report follows:

1. Committee members have been selected.
2. Two approaches are being considered:
   (a) To test the joint as part of the container such as by subjecting it to a drop test where the joint is subjected to the stresses and will come to failure.
   (b) To test the joint solely by itself. This involves segregating the joint from the container and subjecting it to one of the known tests, such as tensile, which can bring the joint to fracture and give a numerical reading as to the value.
3. Methods are being selected for the two approaches.

F. A. Wilcox reported on nomenclature. His selection as Chairman of the Subcommittee on "Nomenclature" was confirmed. Mr. Wilcox and his committee have selected a large group of words that had been authenticated by various groups in the packaging field. For instance, the Waterproof Paper Manufacturers Association had authenticated a series of words, and added words of their own which were pertinent to their own industry. These words had been authenticated industry-wide within their own association.

The Container Committee of TAPPI had also submitted a list of words authenticated within their own committee as being pertinent to their own industry. Other words had been authenticated by the American Paper and Pulp Association printed in its Dictionary of Paper. The Wilcox committee will boil down some meanings, an attempt will be made to clarify them so that they will fit into the scope of the work covered by the Container Testing Committee. In this connection, this Committee will handle the absorption of the

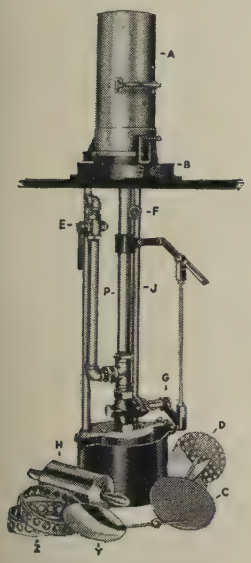
J. H. Heuer, Great Northern Paper Co., Chairman, Coating Committee



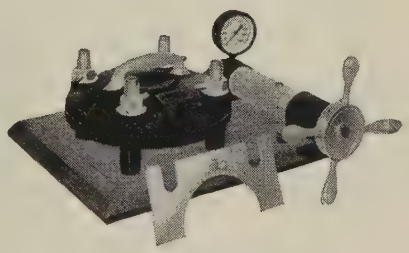
C. H. Krebs, Atlas Boxmakers, Inc., Chairman, Container Testing Committee

ASTM standard D 996–50 as a TAPPI standard and work with the Joint ASTM-TAPPI Joint Committee on Container Testing so that any words developed for this committee can be absorbed into the ASTM standard.

Charles Zusi reported on the circulation of a questionnaire which he circulated to members of the container industry to



★ SHEET MACHINE
DRYER RINGS
AUXILIARY EQUIPMENT



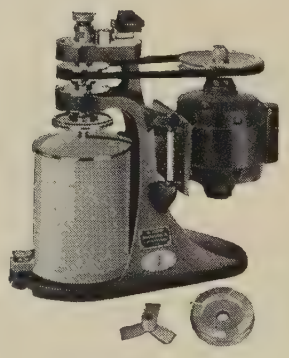
★ PUMP AND PRESS

★ TAPPI STANDARD

PULP TESTING—SHEET MAKING APPARATUS

Fibre Classification Grid—Used With Sheet Machine in Place of Standard Grid Plate

Also: Clark's Laboratory Kollergang Beater



★ DISINTEGRATOR

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try to determine on a unified method for the measurement of containers. His appointment as Chairman of the Subcommittee for the Determination of Methods of Measurement was verified by the committee. His report on this committee follows:

Scoring Allowances—Tentative Summary

(Feb. 28, 1952)

Panel Scoring:

A-flute = 12 at $^1/_4$ inch; 10 at $^3/_{16}$ inch
B-flute = 24 at $^1/_8$ inch; 3 at $^3/_{16}$ inch
C-flute = 11 at $^3/_{16}$ inch; 1 at $^1/_4$ inch; 1 at $^5/_{32}$ inch

Note: 17 reported that they reduce the two end panels $^1/_{16}$ inch each.

Depth:

A-flute = 11 at $^3/_8$ inch; 6 at $^7/_{16}$ inch; 4 at $^1/_2$ inch
B-flute = 17 at $^1/_4$ inch; 10 at $^5/_{16}$ inch
C-flute = 10 at $^3/_8$ inch; 3 at $^5/_{16}$ inch

Flaps:

A-flute = 12 at $^3/_{16}$ inch; 4 at $^1/_8$ inch; 1 at $^1/_4$ inch
B-flute = 13 at $^1/_8$ inch; 7 at $^1/_{16}$
C-flute = 18 at $^1/_8$ inch

Interior Packing:

A-flute = 5 at $^1/_4$ inch; 2 at $^3/_{16}$ inch; 1 at $^1/_{16}$ inch
B-flute = 7 at $^1/_8$ inch; 3 at $^3/_{16}$ inch
C-flute = 1 at $^1/_4$ inch; 1 at $^5/_{32}$ inch; 1 at $^1/_8$ inch

CHARLES J. ZUSI, *Chairman*
Container Measurements Subcommittee

Ed Dahill reported on suggested methods for testing fiberboard in categories over 250 pounds. His appointment as Chairman of a Subcommittee for Testing Fiberboard in Categories over 250 pounds was verified by the committee. His report on the work of his committee follows:

The Mullen paper tester had long been considered a proper and acceptable testing device in the paper industry, so when around in 1910 corrugated fiber boxes were introduced it was not surprising that the Mullen machine was accepted as a tester for this new paper construction. When Rule 41 was prepared the Mullen test was incorporated within this Rule, and since that time both TAPPI and ASTM have included the Mullen or Cady machines as standards in their specifications.

No argument is here presented against the Cady or Mullen test on single sheets of paper, regardless of the basic weights.

With the advances in the art and science of making fiberboard, test requirements have jumped from a top of around 250 to 600 and 700. It has become very impracticable to get representative Mullen tests on strong single and double-wall corrugated board, for such tests usually result in a double pop, which must be thrown out.

Now, if a test is to be set up which to a desirable degree, simulates the actual conditions met with in use, then the Mullen test for either a solid fiberboard or double-faced corrugated board box is not a satisfactory testing device. This for the very fundamental reason that the Mullen test is a steady push of a rubber diaphragm against a one square inch area until the fiber is burst. In actual usage, seldom is this type of concentrated stress brought upon fiberboard boxes or fiberboard drums.

The nature of practically all stresses met with in handling and transportation is that of an impact, and it may be concentrated at one point or it may be spread over the entire face or area of the side of the container. There is another characteristic of fiberboard which should be tested; namely, so-called "fatigue," but I am not here discussing that feature.

What test then have we available at this time that could be substituted for the Mullen test on a solid or corrugated container? These may be listed as: (1) Beach Puncture Tester, (2) Conbur Incline Impact Tester, (3) Drop Tester, (4) Drum Tester. Of these four devices the Beach test is the one that could be more readily used, as it takes up the least amount of space; is not costly; could be used by box users to test or control the boxes or drums they might buy. It does simulate an impact of a sharp concentrated force. It has its shortcomings in that it is a test of the material and not of the completed container, also it presents a concentrated force on a small area.

The Conbur incline impact test is a test of the completely filled and closed container, but it does take up quite a bit of space

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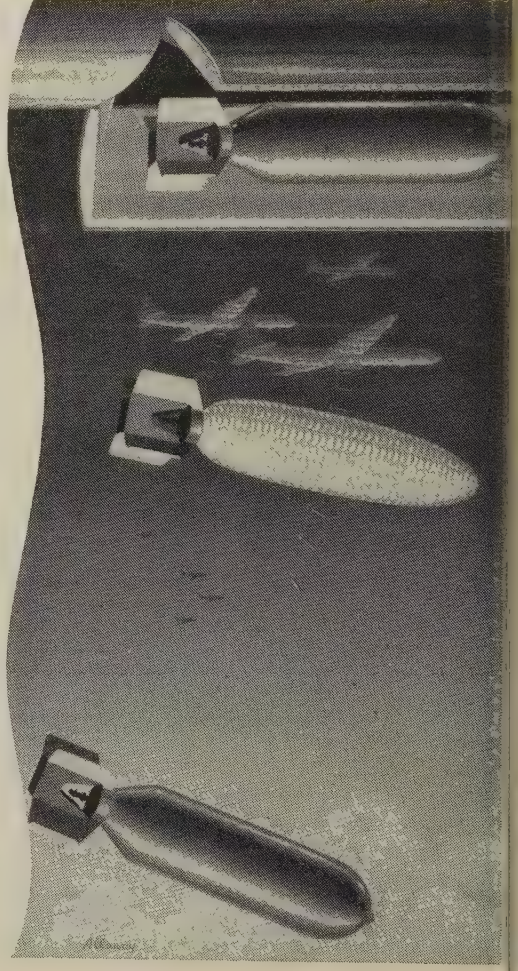


although it is simple in construction and does not require any special devices. It approaches the character of the actual stresses and strains brought upon a package while in actual use.

The Drop test is one that might be performed with a simple device, either purchased or homemade. It stimulates actual-handling, but has its drawback in that it is difficult to reproduce a series of tests exactly.

The Drum test requires a heavy large device occupying quite a bit of room, and as with the Drop tester it is not possible to exactly reproduce any one particular series of tests. This device, however, is excellent to determine the retention of the contents of a package.

While not mentioned in this list, it should be noted that the classification has included a number of performance tests on containers for specific articles, and the tendency seems to be to require performance tests.

I offer these comments not as a solution to the problem, but rather to stir up your thinking and possibly you may be able to originate some device not now on the market, or you might be able to correlate the various results of the tests that are now available, to give a better measure of the serviceability of a shipping container, especially those now required to have a high Mullen test.

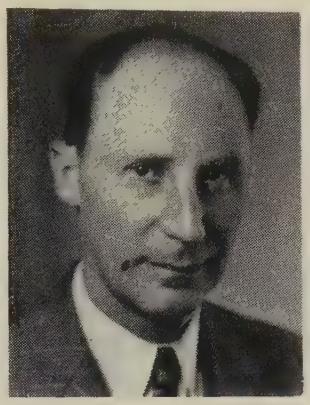
EDW. J. DAHILL, *Chairman*
Testing of Fiberboard Subcommittee

Charles Zusi reported on the possibility of making movies of accepted test procedures. The entire program was shelved temporarily. His report as chairman of this subcommittee follows:

As you know, I was charged with the project of obtaining information on the preparation of a motion picture which could be used in demonstrating TAPPI Testing Method T 802 m which covers the drop test. I conferred with a number of people in the industrial motion picture business, giving them preliminary information on what was required in this film and learned several things from them.

These people gave rough estimates ranging from $2000 to $20,000 for a black-and-white, one-reel picture of the drop test. I then went into greater detail on the problem with Donald A. Scholz of Journal Films, Glenview, Ill. Mr. Scholz and his parner, Gilbert Altschul, came to the laboratory and discussed the problem thoroughly with me. The result of this meeting is shown in the letter from Mr. Scholz, which is quoted below.

To supplement this information, I investigated further through the American Management Association and from their research files obtained the following general information.



C. J. Zusi, Container Testing Laboratories, Inc., Chairman, Container Measurements Subcommittee

C. S. Macnair, Acme Steel Co., Secretary, Container Testing Committee

A simple straightforward one-reel, low-budget film can be made for $5000 and up. A 16-mm. Kodachrome would cost somewhere between $3000 and $20,000. A 35-mm. ranges between $3000 and $40,000 per reel and 35-mm. color from $15,000 to $25,000.

Supplementary information is that a 16-mm. film runs 40 frames per second and is about 400 feet long. A 35-mm. film has 16 frames per second and is about 1000 feet long. A reel of either size will run about 10 minutes.

Mr. Scholz's letter of Jan. 12, 1952, reads as follows:

"We are sending you this letter to recapitulate the high spots of our discussion last Saturday. Due to the fact that the project

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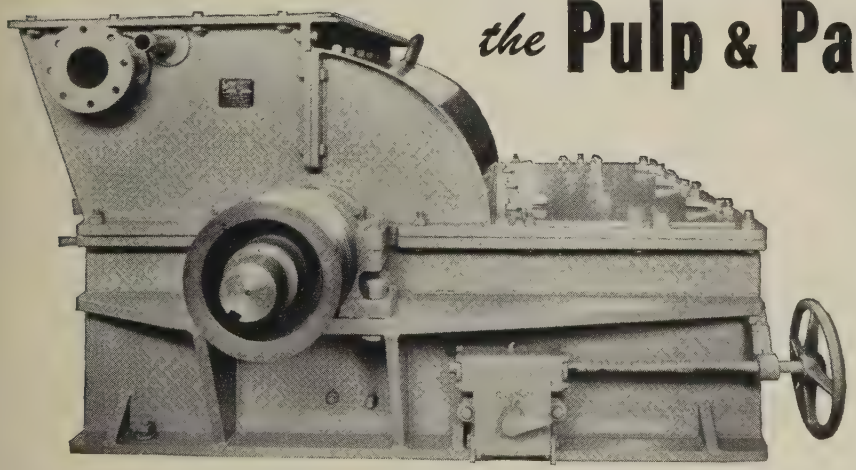

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is in such an early stage—from a film point of view—we do not consider this to be a bid.

"Our understanding is that TAPPI wishes to produce a motion picture that will clearly portray the drop method for testing fiberboard boxes according to T 802 m. Further, that the film will primarily be for use with relatively unskilled people employed by shippers and users of boxes, in their plants.

"The arrangement we discussed was that you would provide the space, properties, and demonstrators; and that we would provide a complete first-rate production service. This service would include script, direction, camera crew, laboratory service, sound service, titles, and editing.

"On the basis of your demonstration of the tests we feel confident that we can deliver to your organization a quality black-and-white film, 10 to 15 minutes in length, for a sum not to exceed $3500. It is possible that after we have a better knowledge of the subject matter, certain economies can be effected which might reduce the cost to $3000. The cost of producing the film in color would be approximately 10 to 15% higher.

"We wish we could adequately state our enthusiasm for your project, not only because of the work it may provide, but also for the nature of the project itself. As we understand it, there are no promotional pretensions, but an honest, sincere effort to present useful information."

CHARLES J. ZUSI, *Chairman*
Testing Movies Subcommittee

Ed Petse was selected Chairman of a committee to suggest methods of coordination between standards now in TAPPI and ASTM, but differing in techniques and present recommendations of methods of coordination to the ASTM-TAPPI Joint Committee on Container Testing. His work will involve the standards for Revolving Hexagonal Drum, Incline Impact, Drop Test for Shipping Containers, and a Compression Test.

D. M. Martin has been selected Chairman of a subcommittee to write up certain tests which are now tentative standards of ASTM so that TAPPI can adopt these verbatim as tentative standards. These will be prepared in accordance with the regulations of the TAPPI Standards Committee.

Drop Test for Cylindrical Shipping Containers
Drop Test for Bags
Water Resistance of Containers by Spray Method
Vibration Test
Water Permeability of Packages
Water Permeability of Shipping Containers
Penetration of Liquids into Submerged Containers

A meeting of the ASTM-TAPPI Joint Committee on Shipping Containers was held February 20 in Room 1505 of the Commodore Hotel. The meeting was called to order by E. R. Stivers, Chairman. The meeting had to do mostly with the method that will be recommended by the Joint Committee to the TAPPI Committee on Container Testing for presentation of the ASTM tentative test methods. For your consideration the ASTM test methods are given below:

D 996–50, Terms Relating to Shipping Containers
D 782–47, Revolving Hexagonal Drum Test
D 880–50, Incline Impact Test
D 775–47, Drop Test for Shipping Containers
D 997–50, Drop Test for Cylindrical Shipping Containers
D 959–50, Drop Test for Bags
D 951–47 T, Water Resistance of Containers by Spray Method
D 999–48 T, Vibration Test
D 895–47 T, Water Permeability of Packages
D 1008–49 T, Water Permeability of Shipping Containers
D 998–48 T, Penetration of Liquids into Submerged Containers

The following recommendation was presented to the TAPPI Container Testing Committee. It is the recommendation of the ASTM-TAPPI Joint Committee on Shipping Containers that subcommittees of the Container Testing Committee be established to take standards now in both societies but differing in techniques to correlate both standards and present recommendations to the joint committee. The joint committee will present these recommendations to a contemporary subcommittee of the ASTM committee having

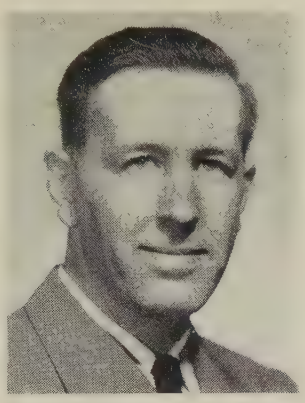
jurisdiction over the method. It was further recommended by the ASTM–TAPPI joint committee that all ASTM standards in this list having no counterpart in TAPPI standards be adopted directly by the TAPPI Container Testing Committee and presented in their present form to the TAPPI Standards Committee.

C. S. Macnair, *Secretary*
C. H. Krebs, *Chairman*
Container Testing Committee

Optical Properties Committee

The Optical Properties Committee met in the West Ballroom of the Commodore Hotel at 2:00 p.m., Feb. 18, 1952. After participating in the meeting of the Testing Division, the Optical Properties Committee discussed the several subjects on its agenda and adjourned at about 5:00 p.m. Present at the meeting were J. A. Van den Akker, R. S. Hunter, J. L. Parsons, and H. E. Obermanns.

H. E. Obermanns, Hammermill Paper Co., Chairman, Optical Properties Committee



T. V. Forman, Scott Paper Co., retiring Chairman, Pulp Testing Committee

The committee discussed the steps to be taken in developing TAPPI standard methods for calibration of fading lamps and for measuring brightness of fillers. Also discussed were some discrepancies that have developed in measuring contrast gloss of paper at 75°.

Project No. 287—Methods of Calibrating Fading Lamps. The work done by the committee so far was discussed. It was decided that any series of test results should be carried out on as large a number of fading devices as possible to obtain representative results. The Chairman will circularize all those mills using fading equipment with a view to accomplish this. Samples of the NBS paper No. 1554 and possibly others to be prepared will be sent to all those willing to test the papers in their fading devices. Also to be requested from these cooperators will be information on the conditions under which the samples were tested, including temperature (and whether controlled), relative humidity, type of sample backing, bowl condition, type of carbons, etc. Additional information on the type of testing done with the fading device, routine fading times used, etc. Definite fading periods will be requested for the samples sent.

These samples, faded by as many mills as are willing to do so, will be returned to the sender and an attempt made to correlate them with fadings made on the NBS Standard Fading Lamp.

The Chairman will investigate a number of other dyes that might be suitable for dyeing light-sensitive papers to be used as standardizing papers. After preliminary experiments, he will attempt to make up a small quantity of papers with one or more dyes that could be used in a survey of fading devices along with the NBS paper No. 1554. Such papers

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should be as stable to light as possible except for the dyestuff used. The dyestuff should be quite fugitive, but should not change shade on fading.

The committee felt that visual comparisons of faded test papers are only approximations and that for accurate comparisons the test papers should be measured by an instrument capable of measuring reflectance in the proper wavelength range. Since the most common such instrument in paper mills is the G.E. Reflectance Meter, with its principal calibration in the blue portion of the spectrum, it would be desirable to use a test paper that showed the maximum change in this region. This would mean a red, orange, yellow, or green test paper. The NBS paper No. 1554 has its greatest change in the green region.

Also discussed was the suggestion that a simple fading test, using a sun lamp or the like, might be desirable. Lamps of this type emit line spectra which are far different from the continuous spectrum of sunlight and therefore may give erroneous results regarding resistance to sunlight fading. The electric arc using sunshine carbons gives the closest approach to the sunlight spectrum.

Project No. 332—Determining Brightness of Clays. The committee felt that this problem is one concerned not only with clay but with all other filler materials. It was also felt that any testing method should measure the filler material in question in the state in which it would be used in the paper; that is, without grinding to some size finer than it would be used. If a filler is used in a paper in a certain particle size it would seem hardly representative to grind it to some other size to measure the brightness. Moisture contact and compacting pressure are important factors.

The suggestion that fillers be first incorporated into a sheet of paper and then measured to show their effect on brightness was discussed. However, it was felt that the variables of retention and the pulp itself would introduce large errors in such a method.

Glossmeters. The committee discussed some of the difficulties that have cropped up in obtaining correlation between the Bausch and Lomb and Gardner 75° glossmeters. Drs. Hunter and Van den Akker felt that some small differences in the geometry of the meters were the cause of the discrepancies and offered to investigate the situation.

At the invitation of Matthew J. Babey, Chairman, AATCC Committee on Colorfastness to Light, the writer attended a meeting with representatives of the AATCC, ASTM and SPI on Thursday, Feb. 21, 1952, at the offices of the J. C. Penney Co., New York City.

The principal purpose of the meeting was to discuss a proposed draft by the above-mentioned committee of the AATCC for testing colorfastness of textiles. This method is a revision of their older method, but has more careful wording and specification of conditions for testing.

A number of the comments were concerned with fading of textile samples. However, a few points of general interest were discussed:

1. There is some evidence that the intensity of light in the Fadeometer is somewhat greater above center than below so that samples in the upper position would be faded more than those in the lower position. This will be investigated with a possible recommendation that samples be moved up and down during exposure.
2. In answer to the writer's questions on the quality of light produced by the carbons in the Fadeometer, Mr. Norton (AATCC) mentioned that a study of the light quality of various types of arcs and electrodes is being contemplated at the National Bureau of Standards, where a double monochrometer is available for analyzing the arc spectra.
3. An elaborate new experimental model of the Fadeometer was described which permits much closer control over a wide range of temperature, humidity, and arc conditions.

H. E. Obermanns, *Chairman*
Optical Properties Committee

Pulp Testing Committee

The Pulp Testing Committee met on Feb. 18, 1952, and was attended by the following committee members:

L. V. Forman, Scott Paper Co., *Chairman*
G. H. Sheets, Mead Corp.
F. S. McCall (for H. Y. Charbonnier), Union Bag and Paper Co.
L. M. Tyler (for C. E. Brandon), Howard Paper Mills, Inc.

Others present were.

Morris Kane, Kalamazoo Vegetable Parchment Co.
Horace T. Robson, Union Bag and Paper Co.
H. A. Smith, The Mead Corp.
K. M. Guest, National Container Corp.

In the opening portion of the meeting, the Chairman reviewed the Committee's activities for the Testing Division. It was pointed out that several projects had progressed to the point where they could be completed in the near future.

In regard to T 200, the Beater Method for the Laboratory Processing of Pulp, we have continued to assemble information toward a revision which will include a procedure for calibration.

For T 205, Forming Handsheets for Physical Tests of Pulp, we have drafted an alternate procedure for automatic pressing and vacuum couching which has been approved by the committee. The Association in Great Britain has suggested a slight change while the Canadian Association is not in favor of alternate methods.

For T 226, Specific External Surface of Pulp. A revision has been developed, approved by the committee, edited by Mr. Griffin, and is being reproduced for final consideration.

In addition, the 1951 activities have included the development and circulation of a questionnaire on TAPPI pulp testing methods which will provide the committee with valuable guidance for their future activities. Pending the outcome of the replies to this questionnaire, a program of cross checking pulp tests and possibly of research on pulp testing methods can be undertaken.

In the committee meeting which followed, the report of the Subcommittee on Dirt Count was read and discussed. This report follows:

Progress Report—Subcommittee on Dirt in Pulp

During 1951 work has been done with the purpose of establishing a new method for the determination of dirt in pulp.

It was originally as a result of discussions at the 1948 Testing Conference in Pittsburgh that the general feeling of dissatisfaction with the present TAPPI method for Dirt in Pulp (T 213 m-43) became crystallized. Further discussions at Rochester in 1950 clarified the thoughts of those who were concerned in the matter and shed considerable light on the basic principles of the methods now in use.

The work to date is not complete and the conclusions which form the basis for the proposed procedure are almost entirely the result of investigations in one laboratory. In considering this report these facts should be borne in mind.

Fundamental considerations were as follows:

1. The method is to be primarily for referee purposes, applicable to pulps of all types. It must be recognized that no method can be devised which will be satisfactory for routine work in all cases and that substantially all makers and users of pulp would retain their own routine methods.

2. Since all pulp is now prepared in sheet form a standard sheet preparation must be used.

3. The light (transmitted or reflected) must be standardized. Common or easily reproducible equipment must be chosen.

4. Since there is a large variation in the character of dirt in pulp this factor must be considered.

(a) It is believed a dirt identification procedure should be incorporated in the method as an appendix.

(b) Speck size must be determined. Equivalent blackness measurement can be provided for in the appendix.

(c) The separate counting of shives is not considered to be a fundamental requirement. Such information is obtainable from an identification procedure.

To date, two series of investigations have been made. The first, which was made in 1950 was primarily designed to establish a dirt counting procedure embodying the fundamental considerations.

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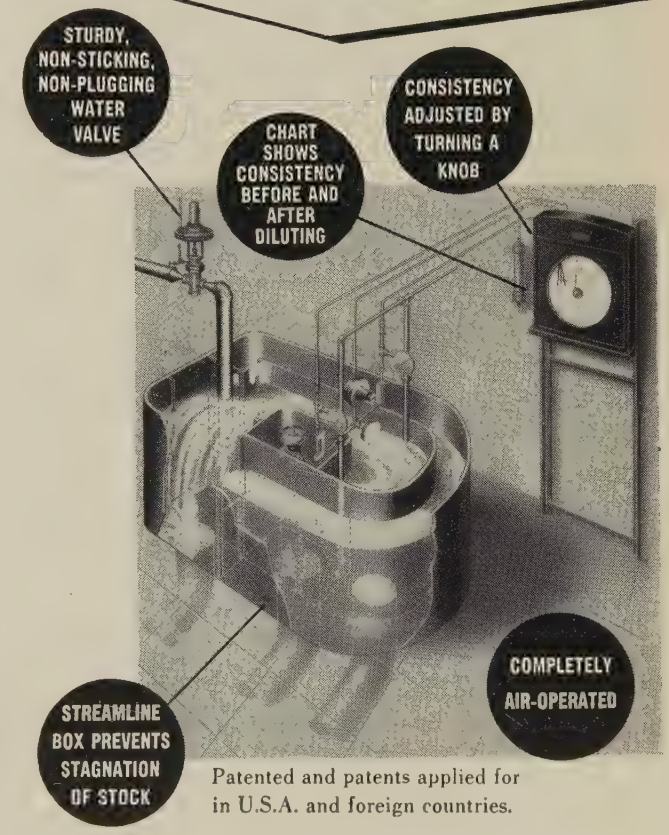
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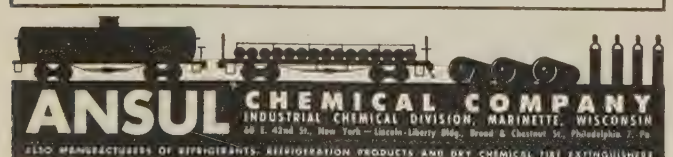

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Subsequently, variations of this procedure have been made and investigated to determine the importance of the variables.

As a result of this work the following conclusions were made:

1. Using prepared sheets with either reflected or transmitted light, the effect of sheet weight is negligible. This means that sheet area controls and results cannot be expressed on a weight basis. It was found that values of the same order are obtained when the sheets are varied from 1 to 10 grams.

2. Sheets prepared in the British sheet mold are two sided, and therefore must be counted on both sides. In this connection it was established that pulp sheets from the drying machines are also two sided with respect to dirt. This was true of sheets from several sources.

The procedure also provides an optional method of sheet preparation in accordance with T 218 m-48 Forming of Handsheets for Optical Tests of Pulp.

3. Sufficient sheets must be viewed to give 30–50 observations. The minimum speck size of 0.04 sq. mm. was chosen as the smallest readily visible.

4. The British disintegrator was chosen to break up the sample since it is common equipment in most laboratories. The time of mixing is considered sufficient for all samples. There is no doubt that some breakup of dirt occurs; however, it is believed that the effect will not seriously affect the rating of pulps.

5. When using reflected light and measuring dirt area the illumination is not critical as long as it is adequate. Both the source and its location are specified for purposes of standardization. The choice of a sloping table top for viewing was to reduce fatigue.

6. Both reflected and transmitted light give substantially the same numerical results when used with prepared sheets up to 10 grams in weight. It was also found in terms of specks/unit area that about the same values were obtained on machine pulp sheets using transmitted light as the prepared sheets. The choice of reflected light was made because the actual counting is less difficult and also because the light arrangements are not critical.

The following procedure has been chosen:

Weigh approximately 4 grams of A.D. sample and place in British disintegrator with 1500 ml. of distilled water for 5 minutes. Divide the mixture into two parts and make two sheets on the British sheet mold according to the TAPPI method for forming sheets (T 205 m-50) except that a blotter is used instead of a chrome or stainless plate. Press at 50 p.s.i. for 5 minutes and then place in drying rings and dry in humidity room for 4 hours.

An optional procedure for the forming of these sheets is in accordance with T 218 m-48.

Repeat above procedure until 6 sheets have been made taking care not to introduce dirt into sheet.

The number of sheets may be varied depending on the amount of dirt in sample but 30–50 readings should be a minimum.

Count both sides of each sheet by reflected light using the TAPPI dirt estimation chart to determine the size of the specks noting all specks 0.04 mm.^{2} and over. Report results as mm.^{2} per square meter

For samples from the same source a speck count may be made counting all specks over 0.04 mm.^{2} and reporting results as number of specks per square foot.

A Dazor Model UL-P2134-16 (Dazor Mfg. Co. 4481-87 Duncan Ave., St. Louis 10, Mo.) having two 15-watt fluorescent daylight tubes or the equivalent shall be the light source. The light source shall be 15 inches above the horizontal center line of the sheet. The table top shall have a black cloth cover so as to offer a black background to sheets placed upon it.

The table top should be inclined at 30° from the horizontal. This permits the dirt to be viewed with the eye normal to the surface of the sheet.

When counting dirt place a blotter or some similar white substance cut to the same size as the sheets under the sheet. This will prevent the black background from showing through thin spots in the sheet and causing errors in the observations.

To date, this procedure and investigation results have been sent to all members of the committee for review and comment. All have agreed to conduct work in their laboratories with a view toward confirming the conclusions.

Comments have been received from the other members which indicate a general agrement but question certain points. It is felt that further work will assist in resolving the differences that exist.

The following is planned to bring this work to completion:

1. Independent investigations (which are committed) of the procedure as presently outlined by the several laboratories.
2. Revision on the basis of the results found.
3. The preparation of a suitable appendix to this method, to include: (a) dirt identification procedure (this will include a shive count procedure); (b) equivalent blackness procedure.

4. Submission of the final procedure to the Pulp Testing Committee for full adoption or rejection.

R. I. Thieme, *Chairman*
W. F. Holzer
George H. Sheets
C. E. Brandon
Dirt in Pulp Subcommittee

Other subjects covered were the "Sampling of Pulp for Testing," "Disintegration of Pulp Samples for Freeness Test," "Mechanical Estimation of Dirt by Means of the Instrument Developed in Canada," and plans for the Fall Testing Conference.

L. V. Forman, *Chairman*
Pulp Testing Committee

Statistics Committee

The Statistics Committee met in the Ball Room of the Commodore Hotel, New York, N. Y., at 2 p.m., Feb. 18, 1952. Those present were:

J. F. Langmaid, Jr., S. D. Warren Co., *Chairman*
E. D. Sutherland, Personal Products Co.
O. H. Somers, Western Printing & Litho Co.
C. A. Bicking, Department of Defense
R. L. McCray, Crossett Paper Mills
F. R. Sheldon, Buffalo Electrochemical Co.
R. T. Trelfa, Watervliet Paper Co.
G. Beall, University of Connecticut
G. Broughton, Lowell Textile Institute
H. K. Collinge, Howard Smith Paper Co., Ltd.
J. A. Greg, S. Curtis & Sons
J. McCauley, S. Curtis & Sons
W. F. Holzer, Crown Zellerbach Corp.
P. M. Schaffrath, Oxford Paper Co.

1. *Election of Chairman.* Mr. Langmaid was unanimously re-elected Chairman of the Statistics Committee. Mr. Trelfa expressed the appreciation of the committee in relating the advances made during Mr. Langmaid's chairmanship during the past year.

2. *Election of Secretary.* In accordance with the suggestion that the secretary of this committee be from one of the allied industries, Maynard S. Renner of the Dewey and Almy Chemical Co., Cambridge, Mass., was unanimously elected in absentia.

3. *Activities of the Committee.* Mr. Langmaid reported that two major undertakings were started this year in the form of subcommittees. These consisted of a group headed by Dr. Broughton to investigate the preparation of a manual of statistical methods applicable to the paper industry and a group headed by Dr. Beall to organize a short course in statistical methods for paper technologists. The chairman of these committees reported as follows:

A. Dr. Broughton reported on the development of a survey of paper mills to determine the statistical methods used and the departments employing them. From these data it was decided to organize a "data sheet" type proposed method for basis weight control charts based on the work of Bicking and Trelfa. This sample control chart data sheet would be circulated to about 40 mills for criticism.

The question of financial assistance to the Chairman for clerical work in preparing these sheets was brought up and Mr. Holzer explained the method of setting up a TAPPI project which would, if approved, help finance this function of the committee.

There was considerable discussion of the wisdom of starting the data sheet series with a control chart example. The consensus favored its use as a more readily applied form of evaluation for those just starting out in statistical applications.

B. Dr. Beall reported on the work done by the committee in conjunction with Dr. Kimball of the University of Maine on the proposed short course in statistical quality control at Orono, Aug. 4–15, 1952.

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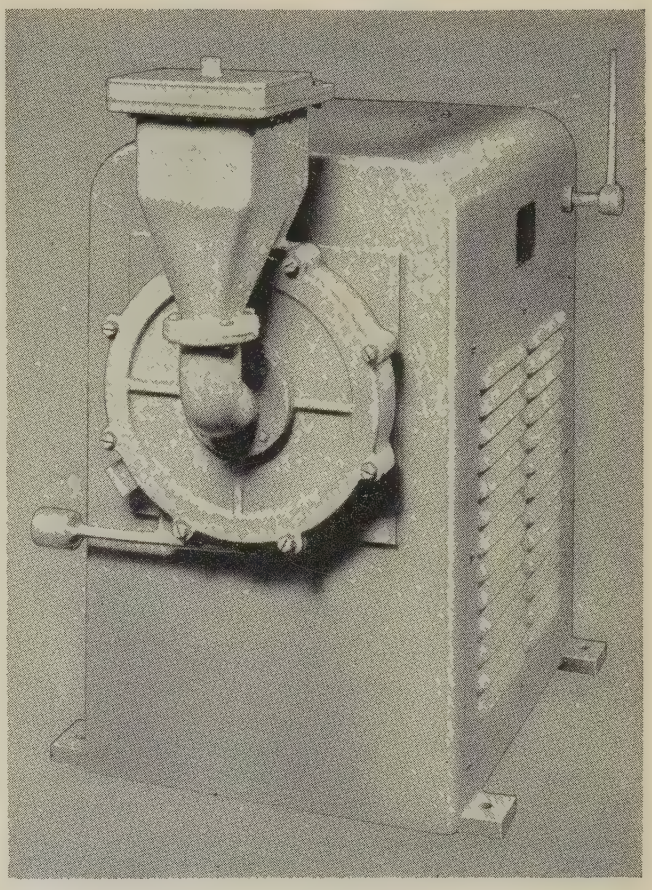

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The program as outlined would consist of a series of lectures presenting the background of statistical methods used, supplemented by a series of speakers reporting actual trials, triumphs, and failures in the application of these methods. There had been some disagreement as to the scope of the program to be undertaken and the final decision listed the following subdivisions:

(a) Problems of Attributes.
(b) Measurable Strength Characteristics.
(c) Measure of Variance and Partition of Variance.
(d) Regression.

The financial arrangements for the course were discussed. It was proposed that each student attending be charged $175 which would cover room, board and tuition. A minimum of 25 students would be required. The compensation for regular lecturers was suggested as $400 plus subsistence. On this basis, the expenses would amount to about $2500 and the receipts to about $3750.

Lecturers tentatively engaged are Drs. Beall and Kimball and Mr. Bicking. Speakers contacted are Messrs. Hinchen, Blew, and Geiger. Dr. Kimball would act as business agent with the University of Maine in making arrangements.

Active discussion followed the presentation of this report centering about the amount of work to be covered and the level at which the presentation was to be made. The general feeling was that the schedule as presented was too full and would be difficult to assimilate. There was also some feeling that, as a first course, subject matter was fairly advanced. A vote was taken on the basis of the following suggestions:

1. Basic course (1).
2. Combination basic and semiadvanced (7).
3. Semiadvanced.

The matter was further discussed as to the advisability of having one week devoted to basic courses and one week to semiadvanced work. It was left up to the subcommittee to work out details which would be practical.

Mr. Somers asked whether the course would be given in other sections of the country. It was felt that much would hinge on the reaction to the presently planned course in Maine.

Old Business. Mr. Langmaid reported on the status of projects suggested at the Groton meeting in the Summer of 1951.

1. Finishing Room Sampling Plans. Nothing new has been developed but a subcommittee chairmanned by Mr. Bicking has been established to contact the National Bureau of Standards for help on this problem.

2. Development of a Simple Machine to Calculate Standard Deviation. None currently available and not much interest shown in building one. It was suggested that anyone hearing of such a machine contact the chairman.

3. Bibliography. Mr. Trelfa has completed the bibliography and it will be published in *Tappi*. It was suggested that the Chairman order 500 reprints for distribution.

4. Book Reviews and Reviews of Current Articles. It was decided after some discussion that the committee be surveyed for ability to scan magazines and books for applicable material. Abstracts could then be submitted or references to the chairman if reviewer felt work beyond his scope.

5. Missionary Work. Mr. Langmaid suggested further work with local TAPPI sections in presenting material on statistical quality control.

A suggestion was made by Mr. Somers that TAPPI adopt as standard the terminology and symbolology of the ASQC and ASTM in order that all are in agreement. This was put into the form of a motion and unanimously approved.

The question was raised as to whether TAPPI had representation on the ASTM committee handling paper sampling methods. It was suggested that the TAPPI statistics committee be advised by other organizations of standards relating to paper sampling or paper test evaluation.

Mr. Trelfa raised the question of committee action on articles in periodicals which give false or incomplete concepts of statistical quality control. Considerable discussion was stimulated but no action taken. Mr. Bicking pointed out that ASQC was particularly active in maintaining the standards in this respect.

JOHN F. LANGMAID, JR., *Chairman*
Statistics Committee

Fundamental Research Committee

The Fundamental Research Committee of TAPPI was reorganized on Tuesday afternoon, Feb. 19, 1952. The earlier committee had served long and faithfully, and it was felt it had achieved the initial purpose for which it was

J. F. Langmaid, S. D. Warren Co., Chairman, Statistics Committee

R. I. Thieme, Soundview Pulp Co., Chairman, Pulp Testing Committee

organized—namely, to stimulate a real interest in fundamental research on the part of the members of TAPPI. Now it appears to be the time that a new committee should be organized to enter into the second phase of fundamental research activities of TAPPI—namely, the planning of long-range research and long-range programs for the dissemination of the results of such research and for planning further research. The following men were on hand for this reorganization meeting: G. A. Day, Brown Co.; G. K. Dickerman, Consolidated Water Power & Paper Co.; R. M. Dorland, Abitibi Power & Paper Co., Ltd.; D. T. Jackson, Hammermill Paper Co.; J. R. Salvesen, Marathon Corp.; J. C. Wollwage, Kimberly-Clark Corp; Gerald Haywood, West Virginia Pulp and Paper Co., and Harry F. Lewis, The Institute of Paper Chemistry. Walter Holzer, Crown Zellerbach Corp. and Chairman of the Research and Development Division of TAPPI and a member of the TAPPI Executive Committee, also attended the meeting. Two other men agreed to serve on the new committee: W. M. Hearon of the Crown Zellerbach Corp. and R. H. Savage of The Mead Corp.

It was decided to set up, for the first year at least, an informal organization with Harry F. Lewis acting as Chairman. The first item of business had to do with the continuing activities of the original Fundamental Research Committee. It was agreed that we should certainly proceed to cooperate with the Canadian Fundamental Research Committee for the 1953 joint meeting on the subject of "Fundamentals of Paper Machine Operation." This meeting will be held in the Spring or Summer of 1953 in the United States—probably at Appleton, Wis. One of the first problems to be undertaken by the committee is that of making recommendations for program content and speakers. This will be one of the main items of the second meeting of the committee which will be

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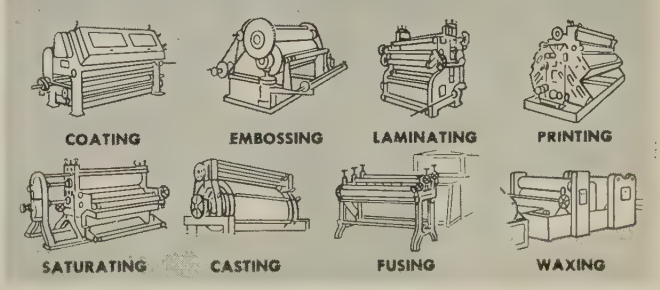

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held in Appleton, Wis., on May 14, 1952. Recommendations from that meeting can then be forwarded to the Canadian group on the occasion of their Summer meeting in June of 1952.

The committee considered an extension of the work of Manning A. Smith at Bucknell University dealing with further studies on lignin but decided to postpone any consideration of the specific item until they would have time to go over the broad program of fundamental research and committee activities. At the May meeting the committee will bring up potential projects which might be sponsored through TAPPI research appropriations.

Considerable time was given in the committee meeting to considering the problem of technical man power in the pulp and paper industry and what the fundamental research group could do to stimulate interest in technical work and particularly in technical work in the pulp and paper industry.

Following this the meeting was adjourned to meet again at 9:00 a.m. the morning of May 14 at The Institute of Paper Chemistry, Appleton, Wis.

HARRY F. LEWIS, *Chairman*
Fundamental Research Committee

Microbiological Committee

The Microbiological Committee met on Feb. 18, 1952, at 2:20 p.m. at the Commodore Hotel, New York City, with R. F. DeLong, Chairman. Mr. DeLong announced the addition to the committee of J. W. Appling, G. A. Cruickshank, and Fred Moden (Anglo-Canadian Pulp & Paper Mills, Ltd.).

Committee members who were present were J. W. Appling, Buckman Laboratories; G. A. Cruickshank, National Aluminate Corp.; R. F. DeLong Marathon Corp.; H. C. Fisher, Gardner Board & Carton Co.; and B. F. Shema, Institute of Paper Chemistry.

Also present were W. F. Holzer, Crown Zellerbach Corp.; C. H. Humiston, Dow Chemical Co.; F. J. Schackel, Mallinkrodt Chemical Works; H. C. Stecker, Gallowhur Chemical Corp.; R. S. Williams, R. T. Vanderbilt Co.; and L. J. Vinson, Lever Brothers Co.

Mr. DeLong announced the appointment of G. A. Cruickshank as Secretary of the Microbiological Committee for the year 1952.

Plans for the 1953 meeting were discussed. It was pointed out by Mr. Cruickshank that there are very few trained bacteriologists in the TAPPI organization and that it might be desirable to initiate an educational program to acquaint the membership of TAPPI with the fundamentals of bacteriology with particular reference to the relationship of bacteria and fungi to paper mill problems. Considerable discussion followed and it was agreed that such a program would be worth while. Mr. Holzer suggested the possibility of publishing a monograph on the relationship of microbiology to the paper industry, and pointed out that money would probably be available from the TAPPI Research Fund for such purposes. This suggestion was unanimously approved and the Chairman appointed a subcommittee consisting of J. W. Appling, Chairman, G. A. Cruickshank, and B. F. Shema to investigate the possibilities of such a publication.

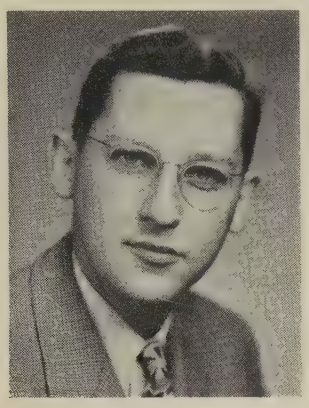
It was agreed that the program for the 1953 meeting should be educational in nature and that the Chairman would attempt to secure the services of a prominent microbiologist to deliver an address on the fundamentals of bacteriology. The principal address would be followed by short talks by other speakers on specific items of particular interest to the paper industry.

Mr. Holzer requested that the Microbiological Committee review the present TAPPI Microbiological Standards and make any revisions that appear necessary.

Mr. DeLong reported on a series of round-robin tests

conducted to determine the effect of sample size on the reproducibility of bacterial counts on paperboard. No conclusions could be drawn from the results of these tests since the samples tested by the cooperating laboratories showed extremely low counts. In the discussion of this problem it was the consensus of opinion that the committee should recommend revision of Tentative Standard T 449 m-49 to require a 5.0-gram sample in place of the present requirement that not less than a 2.0-gram sample be used.

H. F. Lewis, The Institute of Paper Chemistry, Chairman, Fundamental Research Committee



R. F. DeLong, Marathon Corp., Chairman, Microbiological Committee

Mr. Shema reported for the Subcommittee on Mildew Resistance Testing and, following the report, a considerable portion of the meeting was devoted to drawing up an outline for a Tentative Standard Method for Mildew Resistant Paper and Paperboard. Agreement was reached on all essential points and the Method will be submitted to the Microbiological Committee for approval.

Mr. Fisher asked to be relieved of his duties on the committee because of a change in the manufacturing schedule of his company and his resignation was accepted with regret. Harry has been a member of the Microbiological Committee since its inception and has rendered faithful service characterized by a high degree of common sense and understanding.

There being no further business the meeting was adjourned at 5:30 p.m.

Addendum to minutes of committee meeting:

On Tuesday, Feb. 19, 1952, at 2:00 p.m. a program of 5 papers was presented under the auspices of the Microbiological Committee with R. F. DeLong as Chairman. About 75 persons were in attendance. The program included the following papers.

1. "A Method of Laboratory Evaluation of Chemicals as Potential Slimicides," by S. I. Cohen and Marcine Kahn, Gallowhur Chemical Corp., New York, N. Y.
2. "Performance of Paper Machine Wet Felts. II. Further Studies of the Plugging of Felts," by D. W. French and C. M. Christensen, University of Minnesota and S. J. Buckman, Buckman Laboratories, Memphis, Tenn.
3. "Lever Spore Cloud Method for the Evaluation of Antimycotic Properties of Paper and Paperboard," by L. J. Vinson, Lever Bros. Co., Cambridge, Mass.
4. "Factors Affecting Slime Growth," by L. A. McKeown, Consultant, Plattsburg, N. Y.
5. "Determination of Phenyl Mercury Salts in the Paper Mill System," by Arthur Schwerdle, Vinland Chemical Co., Vinland, N. J.

G. A. Cruickshank, *Secretary Microbiological Committee*

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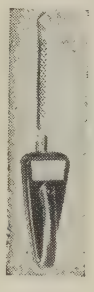

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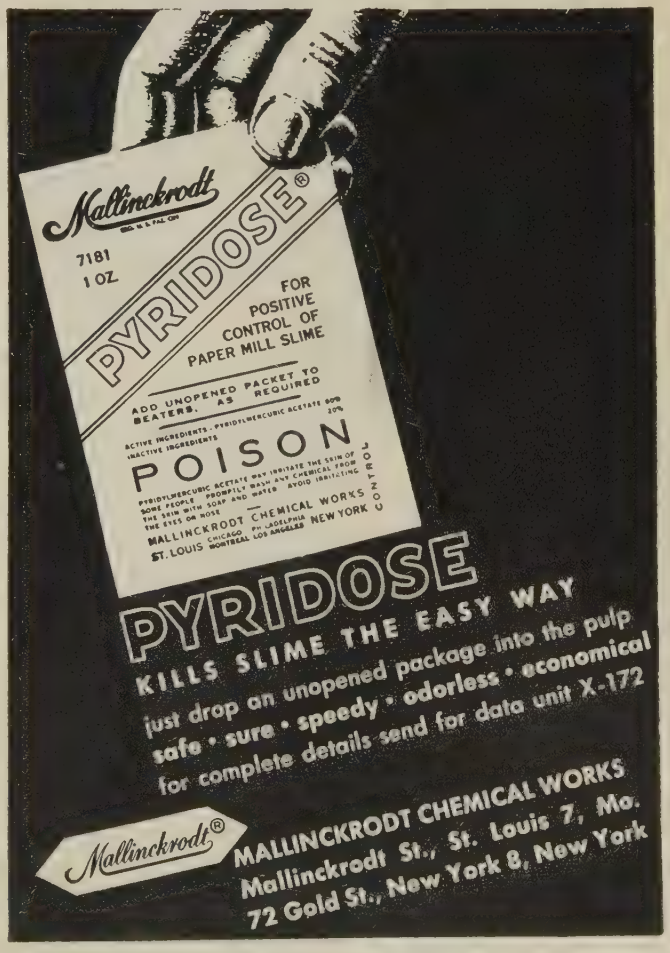
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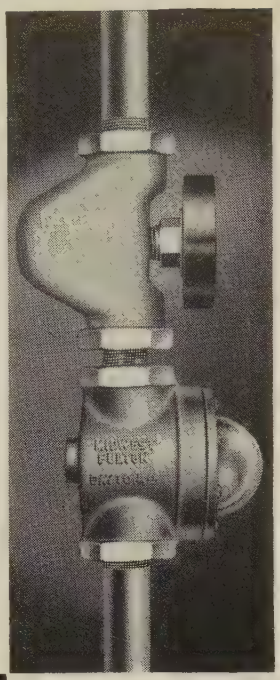

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RECENT BOOKS

Encyclopedia of Chemical Technology. Vol. 8. Edited by Raymond E. Kirk and Donald F. Othmer, Polytechnic Institute of Brooklyn. The Interscience Encyclopedia, Inc., New York, 1952. Cloth, $7^1/_2 \times 10^1/_2$, 944 pages. Illustrated. $30.

The first seven volumes of this series have been reviewed in *Tappi*. The above-mentioned price of $30 applies to this volume only. Individuals or companies who are subscribing to the entire series of ten volumes will be charged $25 for this volume.

Volume 8 covers subjects alphabetically from Ion Exchange to Metal Plating. Included are such subjects as iron, isomerism, isotopes, ketones, laboratories, lamination, lead, leather, lignin, lime, linen, linoleum, literature surveys, lubrication, luminescent materials, magnesium, magnetic separation, matches, mercaptans, mercury compounds, metallic coatings, and metallurgy.

Piping Design and Engineering. Grinnell Co., Providence, R. I. 1951. Cloth, $8^1/_2 \times 11$, 221 pages. Illustrated. $10.

This book which has been prepared by the engineering staff of Grinnell Co. compiles, in a single publication, engineering data and technical information for use of engineers engaged in the design and application of pressure piping systems. It presents information hitherto obtainable from a large number of sources. It covers such details as expansion and stresses, velocity and pressure drop, heat transfer, allowable s-values, pressure-temperature pipe graphs, metallurgical briefs, piping materials, pipe fabrication, pipe hangers and supports, and a large number of tables, including properties of saturated steam, losses from leaks, safe loads, conversion factors, etc.

Chemical Trade Names and Commercial Synonyms. By William Haynes. D. Van Nostrand Co., New York, 1951. Cloth, 6 × 9, 279 pages. Photo-offset. $5.50.

This book is an up-to-date dictionary of more than 20,000 special names used in the chemical industries. It is of particular value to purchasing agents. When possible the name of a supplier is given. An example: Permel (Am. Cyanamid)—various aqueous resin dispersions; durable water-repellant for cotton, wool, and synthetics; shrinkage control fabric stabilization agent.

Quality Control Handbook. Edited by J. M. Juran, Consulting Management Engineer. McGraw-Hill Book Co., New York, 1951. Cloth, 6 × 9, 800 pages. $10.

This book is a reference of industrial know-how on the fundamentals and means of achieving better quality at lower costs. It is designed primarily for reference and use by executives, supervisors, and engineers in industry.

The following major subjects are covered: economics of quality, specification of quality, organizing for quality, acceptance of quality, control of quality, assurance of quality, statistical methods. In the application section, Charles A. Bicking, a member of TAPPI, discusses quality control in the chemical process industries.

Night operation at Coosa River Newsprint Co.

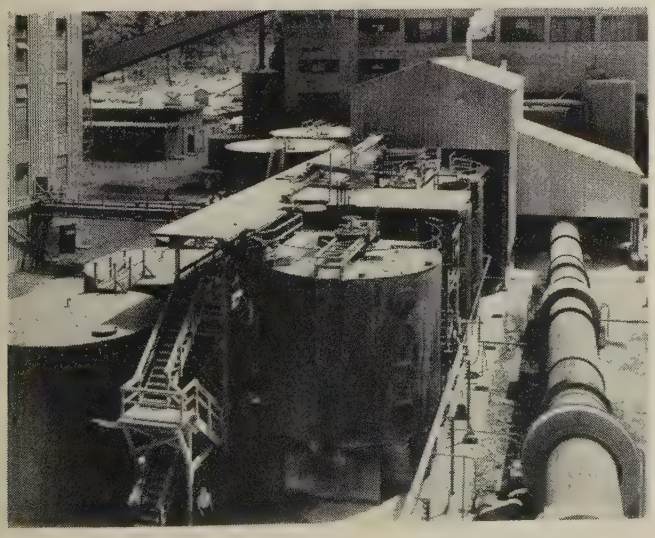
Handbook of Dangerous Materials. By N. Irving Sax, Toxicologist, General Electric Co. Reinhold Publishing Co., New York, 1951. Cloth, 7 × 10, 848 pages. $15.

This reference manual gives concise safety facts and hazardous properties of more than 5000 materials, arranged alphabetically, cross-referenced, and indexed. The major subjects covered are general chemicals, explosives, fungus diseases and fungicides, radiation hazards, and shipping regulations. The latter gives the complete Interstate Commerce Commission shipping regulations.

Corrosion Guide. By Erick Rabald, Manheim-Waldhof, Germany. Elsevier Publishing Co., Houston, Tex., 1951. 7 × 10, 629 pages, 69 folding tables. Illustrated. $12.50.

This book has been prepared for engineers and chemists employed in industrial plants. The book contains three main sections: I. General considerations in the choice of materials to avoid corrosion, principles of corrosion, measurement of corrosion resistance; II. Corrosion tables and physical properties of materials; and III. Bibliography of books and periodicals. The tabular arrangement of data provides a quick and convenient means of obtaining answers to prospective corrosion problems in almost any case. A large portion of the book is arranged in the tabular manner.

Boiler Feed Water Treatment. 3rd Ed. By F. J.



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Write for Bulletin No. 1400. It describes the motor-driven and hand-operated models as well as other Gurley paper-testing instruments. W. & L. E. Gurley, Station Plaza & Fulton Street, Troy, New York.

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Matthews. Chemical Publishing Co., New York, 1951. $5^1/_2 \times 8^1/_2$, 207 pages. Illustrated. $4.50.

This interesting monograph, now in its third edition, covers such major subjects as natural water supplies, scale formation, corrosion, foaming and priming, and water analysis and routine testing. The appendix includes data on standard solutions, reagents, Clark's table of hardness and chemical factors and conversion tables. Although it is written with a European background it will be of value to most steam plant engineers.

Adhesion and Adhesives. Edited by N. A. De Bruyne and R. Houwink of England and the Netherlands, respectively. Elsevier Publishing Co., Houston, Tex., 1951. Cloth, $6 \times 9^1/_2$, 517 pages. Illustrated. $10.

This book is a symposium by fourteen specialists. The editors are physical chemists. The first part deals with theory. It opens with a chapter on wetting and is followed by a discussion of the various molecular forces which are the basis of adhesion phenomena. The rheology of adhesives, including thixotropy, is next discussed and considerable attention is given to the phenomenon of tackiness.

The second section is devoted to technological aspects. Earl Cornwell of Armour & Co. discusses animal glues. William Lee of Penn. Salt covers starches and other vegetable adhesives. Synthetic resin adhesives is discussed by F. Chapman of Aero Research Ltd. An unusually fine chapter on inorganic adhesives and cements is authored by John H. Wills of the Philadelphia Quartz Co. and Mr. De Bruyne covers physical testing methods. The caliber of the editors and authors assures a text very complete and authentic.

Nomographic Charts. By C. Albert Kulmann. McGraw-Hill Book Co., New York, 1951. Cloth, 7×10, 244 pages. $6.50.

This book contains 92 charts which have been used successfully by the author as time-saving devices on engineering and mathematical computations over several years. Each chart occupies a full page and is accompanied by an explanation to aid in its use. Since each chart is a story in itself it is possible only to indicate some of the titles: Fourth and fifth powers and roots; several other power charts; reciprocals of reciprocal sums; weight of steel plate; lead and velocity; weir and orifice discharges; pipe flow and loss; pipe or tank volume, hydraulic turbine speed; column loading, beam stress; centrifugal force; steam pipe flow; heat losses in flue gases; boiler efficiency; power factor correction, surge impedance and admission, etc.

Corrosion—Cause and Prevention. 3rd Ed. By Frank N. Speller, Corrosion Consultant. McGraw-Hill Book Co., New York. Cloth, $6 \times 9^1/_2$, 686 pages. Illustrated. $10.

Students of corrosion are usually acquainted with the work and publications of Mr. Speller. The present volume is a revision and enlargement of the previous editions. As indicated by the author, since the 2nd edition developments in the knowledge of corrosion, particularly of its prevention, have been remarkable. As in previous editions the author covers theories, influence of manufacturing method, corrosion testing, prevention of atmospheric and underwater corrosion, prevention in steam and hot water systems, cathodic protection, etc.

Note: All of the books reviewed in *Tappi* may be obtained from the Book Department of the Technical Association of the Pulp and Paper Industry, 122 East 42nd Street, New York 17, N. Y.

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Preservation of Baled Straw Stored in Ricks

CHARLES W. WHITE

THE purpose of this paper is to point out to the strawboard industry that with no outlay for additional equipment nor change in techniques, a very appreciable reduction in cost can be realized by preserving the straw that is stacked in ricks and exposed to weather.

On April 1, 1947, a joint meeting of TAPPI Fibrous Agricultural Residues Committee and Chemical Preservative Manufacturers was held at the Northern Regional Research Laboratory in Peoria, Ill. The purpose was to find the best, as well as the most economical, means of preserving baled straw in ricks that are exposed to the elements for periods of 8 months to 1 year or longer.

At this meeting, members of the strawboard industry discussed techniques used to preserve straw. Sodium pentachlorphenate had been tried at a rate of 525 and 1135 pounds per rick on barn-dry straw having little moisture content at the time the rick was erected. Continuous inspections indicated that both treatments gave better straw than untreated ricks, but the higher cost was judged not worthy of the additional $98 expenditure.

Another system used was to cover the ricks with sisalkraft paper. The ricks are topped either in a pyramid or flat surface with the paper extending well down over the sides. All this is held down by small mesh wire and weighed with cement blocks. Several mills reporting on this technique gave unfavorable comments, such as high cost, difficulty in covering, and frequent damage resulting in water being funneled into the rick.

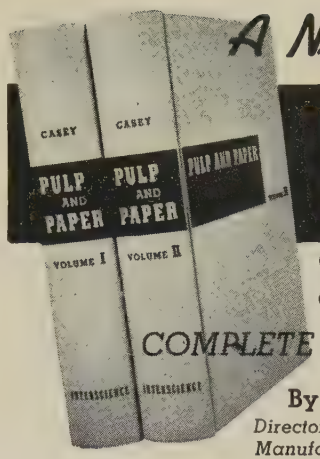
Tarpaulin covering of ricks had been tried in several instances as well as the use of corrugated sheet metal on a wooden framework. Objections were primarily high initial cost, wind damage, high labor costs, and water funneling through damaged areas.

The outcome of the 1947 meeting was a decision to try various chemicals in large-scale preservation tests. Included among the suggested chemicals were pentachlorphenates, various mercurials, creosotes, borax, and boric acid. Each mill was invited to cooperate and compare their tests. Initial tests were to be made on the basis of a chemical cost of $100 per rick and a comparative test of the same material at a cost of $60 per rick. A standard rick was considered to be approximately 50 by 65 feet. Since many deviate from these dimensions adjustments could be made depending on the top surface area.

For the initial chemical preservation investigation, eight mills were able to make comparisons by treating ricks of straw that were expected to be held over for use in 1948. In applying each chemical there were untreated sections equal to one third of the rick held for a check, one third of the rick was treated at the $100 per rick cost, and the remaining one-third rick treated at a $60 per rick cost.

Observations of the test rick left exposed for a period of 10 to 12 months indicated that some of the chemicals were effective for much too short a time. Some were extremely difficult to handle and necessitated special precautions and equipment for the men. Those chemicals requiring a spray application were generally found to be too soluble and quickly leached through the top surface. Corrosive action on baling wire was also noted in some tests. Results in these cases gave a good preservation for a short duration, but subsequently the top straw deteriorated, and the bales became soft, mushy, and supported considerable mold. The only chemicals which seemed to give a preservation for the necessary length of time were the borates. Borax and boric acid both gave

CHARLES W. WHITE, Pacific Coast Borax Co., Cleveland, Ohio.



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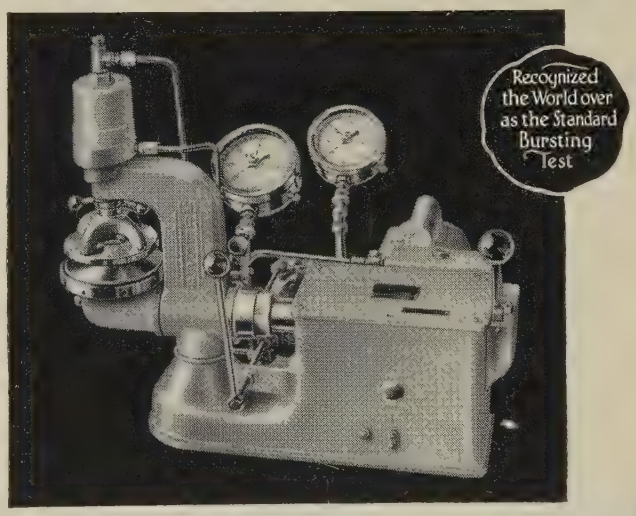

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promising results, and all cooperating mills continued with investigation of borates.

Borax was used at rates from 800 to 2500 pounds per rick. Boric acid was used on a few tests at rates to equal the cost limits established. Boric acid proved to be a good preservation chemical except that it was somewhat corrosive to baling wire, gave an acid condition rather than a basic condition, and the preservation period may be somewhat shorter. The lower rates of application gave a faster solubility which could account for this.

Through all the tests borax received approval. The material could be conveyed up the stacker in 100-pound bags, was applied in dry form by men doing the stacking with no special equipment needed and no danger to the men. The tests indicated that a rate of 1 ton per rick could preserve upward of 25% of the fiber content normally considered lost in the top tiers. Estimates of savings ranged from $200 per rick up to $450 per rick.

The borax-treated straw would make firm top bales that would support one's weight. Many untreated ricks revealed bales so soft they would fall apart on handling. A man walking on an untreated rick 1 year old would readily sink to his knees. The borax-treated straw showed a better toughness of fiber without decomposition so common to the ordinary rick top. The usual crop of wheat and weeds that sprout on the rick top was also controlled by the borax treatment. One example of the contrast was that only one bale was lost from breaking open when dropped from the top of the rick to trucks while destacking five ricks. Each untreated stack had quite a number of bales break open.

For the second year of testing a few changes were made guided by our brief experience. Since borax gave the best results and had been selected as the most practical preservative, a less expensive form of borate called Borascu was recommended. Borascu is a concentrated borate ore that contains approximately 94% borax. The rate of application could be the same and similar results were anticipated. A recommendation of 1 ton of Borascu per rick was made with the suggestion to use a split application. Therefore ricks were treated with 500 pounds of Borascu on the next to top tier and 1500 pounds on the top surface. By a split application it was hoped to make the chemical available to the wet straw in the second and third tier.

The second year of the chemical preservation program found more mills cooperating. Borax or Borascu was used in a manner closely following recommendations. More than 75 ricks were treated with either one or the other of these chemicals, and this straw was marked for a storage period of over 10 months. Since most of the deterioration takes place in the warm weather following Winter exposure, all observations were made after 10 months and compared with untreated ricks.

Again the straw was checked visually with results reported as excellent. The top bales were judged to be in good condition, solid, and well preserved. Bales were broken open and cross sections examined. The treated bales could be handled easily, the wire was in good condition, and the straw was bright and clean. The untreated bales were so soft they promptly fell apart revealing badly decomposed straw throughout the cross section.

The third year of chemical preservation resulted in well over 100 ricks being treated with Borascu and at least four mills treated all new ricks that were to be stored longer than the Winter season. Generally an application of 1 ton of Borascu with a split application on the two top tiers was followed. However in some cases the rate was increased in anticipation of storage longer than 1 year. Reports from some mills revealed wet straw down as far as 7 bales deep, but the straw was in good condition when Borascu had been used. In at least one case heavy rains penetrated 9 bales deep and the underneath straw was found in poor condition. The top tier gave a normal yield, but the next 3 tiers gave 20% less yield. This would indicate a need for Borascu treatment on perhaps the 4 top tiers as the rick is being built. In this instance Borascu had been used only on the top surface.

One good approach to a scientific check on preservation is to progressively check treated and untreated straw for alkali solubility. In an alkali extraction it has been found that solubility varies as follows:

Good straw	40%
Slightly weathered	44%
Medium weathered	47%
Badly weathered	64%

Some checks of borax or Borascu treatments actually showed a marked improvement in alkali solubility over untreated straw but it is felt that more work is needed to establish these results. It is hoped that more mills will be able to run alkali extractions on this year's straw, both treated and untreated, so that detailed information will be available.

The preservation program for 1950–51 has not expanded any due to the shortage of straw and the rapid use of stored ricks. Many mills do not expect to carry over much inventory beyond the winter months, and therefore have fewer ricks to treat. However, the 1951 straw season is expected to give a heavy inventory and it is expected that the number of ricks treated with Borascu will be more than doubled.

RECEIVED Feb. 2, 1951. Presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 19–22, 1951.

The Pacific Coast Borax Co., Division of Borax Consolidated Ltd., expresses its appreciation to the Northern Regional Research Laboratory and to each and every participating mill for the splendid cooperation in conducting straw preservation tests. It is hoped that the industry will benefit from such work, and realize a better processing technique for the manufacture of paper from straw.

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Changes in Equipment and in Operating Practices Which Will Reduce Sulphur Consumption

W. F. McKEE

THIS paper has been prepared through a joint effort of the members of the Sulphite Committee of the Technical Section, C.P.P.A., and is composed of five sections dealing with practices used to conserve sulphur. In effect, the paper is an abstract of the Sulphite Committee's report entitled "Reducing Sulphur Consumption" which was published in March, 1951, to which has been added any new data and ideas that have been developed since that time.

In this paper, methods of sulphur conservation will be discussed under the following headings: (1) maximum gas recovery through pressure reduction before blowing, (2) maximum recovery of acid by means of side relief, (3) changes in cooking practice, (4) acid-plant operation, and (5) increased yield of pulp from wood.

MAXIMUM GAS RECOVERY THROUGH PRESSURE REDUCTION BEFORE BLOWING

A recent survey of some ten mills indicated that a saving of up to 50 pounds of sulphur per ton of unbleached screened pulp can be saved by lowering blow pressure from 35 to 20 p.s.i.g. At the same time, it has been indicated by laboratory cooking experiments that an additional 30 pounds of sulphur per ton of unbleached screened pulp could be recovered by reducing digester pressure at blow from 30 to 0 p.s.i.g.

It is realized that certain arrangements in different mills make reducing digester pressures to a point lower than 30 p.s.i.g. difficult and in some cases impossible without alterations to equipment; however, many of these limitations may be overcome by the proper use of efficient eductors in the relief system.

It is now the practice in some mills to reduce digester pressure to a minimum by the use of eductors and then by the use of steam return to a normal blow pressure.

Probably the greatest limit to full low pressure relief recovery lies in the absence in many mills of sufficient pressure recovery units to handle the relief gases efficiently. In the sulphite pulp industry, where the very economics of operation lie in the recovery of the hot volatile gas, SO_2, from the digester, it should be considered axiomatic that pressure units are essential to complete recovery.

Other factors that effect gas recovery through pressure reduction before blowing are enumerated below:

1. Proper location of blow pits to allow digester to blow clean at low pressure.
2. Blow line and valves of sufficient size to allow clean blows at low pressures.
3. Relief lines of proper size to handle the full volume of relief.
4. High and low pressure relief vessels.
5. Independent recovery towers or tanks to isolate overgas from the acid plant.

MAXIMUM RECOVERY OF ACID BY MEANS OF SIDE RELIEF

The main purpose of removing the liquid side relief is to create a gas space in the top of the digester. As a result of this there is some recovery of heat and sulphur.

There is a minimum amount of side relief which must be removed to prevent liquid entrainment in the dry gas relief. The volume of side relief that can be taken off in addition to this minimum depends upon the following factors:

1. Physical limitations:
   (a) Location of side-relief strainer.
   (b) Location of collector ring.
   (c) Presence of spray nozzle in the top of the digester.
2. Chemical limitations:
   (a) The ratio of combined SO_2 to wood which is influenced by the following factors: percentage of SO_2 in cooking acid; density of wood; amount of chip packing; and dilution with wood moisture and condensate.
   (b) Dilution of accumulator acid.

The height of the side-relief strainer determines the maximum amount of liquid relief that can be removed. The level of liquid in the digester should not be lowered below that required to maintain circulation. When the collector ring is in the top of the digester, the amount of side relief is limited. If there are no spray nozzles in the top of the digester, the liquid level should not be lowered below the level of the chips too early in the cycle or other will be nonuniformity and high waste.

For maximum yield and pulp quality, there is a minimum ratio of lime, or combined SO_2, to wood. This ratio, of course, depends upon the variables listed above. If this minimum ratio has been established for a given set of conditions, it will then be necessary to increase the percentage of combined SO_2 in the cooking acid if the amount of side relief is increased. If, however, the ratio of combined SO_2 to wood is greater than the minimum required, then increased side relief will result in increased sulphur saving without harming pulp yield and quality.

When the same accumulator acid strengths are to be maintained with increased side relief from the digesters, the dilution must be overcome by increased recovery or stronger acid from the acid plant.

When a larger volume of liquid relief is removed from the digester, there is less SO_2 to remove during the blow-back period. For the same blow-back time, the final pressure will be lower. It should be pointed out that with the efficient use of eductors and recovery equipment, this advantage becomes less important. The removal of larger volumes of side relief results in less blow liquor and the loss of sulphur in the blow liquor will be reduced by the amount that the volume of the blow liquor is reduced.

Some mills have reported savings of 30 to 40 pounds of sulphur per ton because of increased side relief. This is partially due to the reduction in blow pressure that they were able to obtain in the same blow-back cycle and probably partially due to recovery of combined SO_2 that was not required for cooking.

For maximum recovery of acid by means of side relief, each mill should determine the maximum amount of side relief that can be removed within the physical limitations mentioned above. The percentage of combined SO_2 in the cooking acid should then be adjusted to give the minimum ratio of combined SO_2 to wood with that amount of relief.

CHANGES IN COOKING PRACTICE

Except for that quantity which is recovered in side relief, all sulphur in the form of combined, above that consumed, is entirely lost to the cooking-acid system. It is discharged into the blow pit along with the pulp. The volume of this acid from digester to digester remains fairly constant in any given mill and is out of the hands of the operator. However, he does have control of the strength of the combined in this acid.

It has been stated elsewhere that certain pulp characteristics are determined by the combined strength. In general, low combined has been reported to yield soft pulp and a high combined, hard pulp. Such a relationship has not been confirmed.

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An ideal control of such residual combined would be a test of the waste liquor. The strength at the end of the cook might be used as a control for the strength of the acid pumped to the digester. Those mills with pulps not affected by combined might then operate so that at the blow a minimum test would be satisfactory. Unfortunately, due to interference by dissolved substances in the liquor, no test currently known is sufficiently reliable.

High combined has the effect of slowing down the rate of reaction in the cooking process. For this reason, with high combined, the cooking time must be increased or the maximum temperature raised. The opposite is also true and therein lies the only danger in the use of low combined. At the point of exhaustion of combined, the fiber itself is rapidly attacked and degraded. This condition is evidenced in a sudden darkening of the cooking liquor. When this happens, the charge must be blown immediately or the pulp will rapidly discolor. In the vernacular of the operator, the "cook has flopped over."

Varying amounts of chips (packing) in the digester require varying volume of acid to fill the digester, which in turn varies the required concentration of the combined sulphur dioxide. The greater the packing, the lower the acid volume and the higher the strength of combined. Once the maximum desired packing has been reached, however, the combined test should be dropped to just above the point at which it will be exhausted at the blow. It should be pointed out, however, that this condition is only possible where there is sufficient control over chip packing to assure uniform charges to the digester.

Chip packing was developed as a means to increase production and to reduce steam costs and has only marginal and indirect effect on sulphur saving. As stated under "Lowered Combined" the more wood in the digester, the less space there is for acid. This, in turn, means less liquor blown into the pits where the chemicals are lost. Therefore, it follows that for any given input of combined sulphur dioxide, the more the digester is packed with chips, the less will be the direct loss of sulphur to the sewer.

There are three adjustments on the standard mechanical packer. The first, the angle of blade, is set to procure a chip surface contour that is slightly convex rather than horizontal or concave. Such a form lends itself to improved circulation. The second adjustment is to the sector plates or the rate of feed. This adjustment has the greatest effect upon the amounts of chips charged to the digester. Sector plate openings should be as small as practicable for maximum digester yield. In effect, such manipulation slows down the filling time and permits some settling of the chips. A filling time of 60 minutes is possible without interfering with production. A filling time of such length is only possible, however, with forced circulation in that a shorter cooking time is permitted. By this means, packing to 12.5 pounds of oven-dry (0.42 density) wood per cubic foot of digester space is being done. The third adjustment is the centering of the chip packer over the digester. Slight deviation in any direction will result in uneven packing which not only restricts filling to capacity but impairs circulation. Steaming of chips during filling also assists in increased packing. This may be done through the bottom steam inlets but the steam flow should be restricted to just below the point at which steam is emitted from the top of the digester; otherwise, it is lost.

Forced circulation is indispensable to maximum chip packing but also bears a definite relationship to sulphur saving in that it assures higher screened pulp yields. More uniform liquor distribution gives more uniform chip penetration. Rejects and fiber degradation are reduced because the cooking operation becomes thorough, with temperatures equalized throughout the charge rather than pockets of undercooked and overcooked chips forming in the digester.

A circulation rate sufficiently high to give an acid "turnover" cycle of around 10 to 15 minutes is to be desired. The maintenance of this rate may be determined by the load on the circulating pump motor. The circulation rate will naturally drop after the side relief has been removed, and this may be as early as 4 hours after the start of the cook if maximum temperature has been reached. However, circulation should be maintained throughout the entire cooking operation for most uniform results. Even though the removal of the side relief may drop the liquor level in the digester below the top of the chips, as long as these chips are continuously wetted by circulating acid, no "burning" of the chips will take place.

Presteaming is accomplished by the addition of steam through the bottom fitting of the digester while it is being filled with chips.

The purpose of this practice is twofold, the first being to obtain a moderate degree of chip packing and the second, to bring about a more rapid penetration of the chips by the cooking acid.

Considering the first purpose of presteaming, it can be safely stated that several mills utilizing this practice have obtained chip packing to a degree of 6% without experiencing any drop in pulp quality or increased difficulty in blowing even when cooking with natural circulation. The increase in pulp yield coupled with a corresponding decrease in the acid-to-wood ratio results in moderate sulphur savings.

The second purpose of presteaming, that of more rapid penetration, is reported by some mills to result in a reduction of sulphur consumption to the extent of 8 to 10 pounds per ton of unbleached screened pulp.

In theory, it is believed that presteaming heats and opens the chips and removes a portion of the inert gases which impede penetration. By so doing, presteaming enables a faster rise to temperature and, in a fixed cycle, allows a longer blowdown period. Side relief can be started earlier and more can be removed.

The degree to which presteaming can be practiced is limited to individual mill operation. In some mills, steam is admitted through the bottom fitting as soon as the bottom cone has been filled with chips and is continued until the digester has been filled and the cover bolted on. Full presteaming can result in a considerable degree of chip packing and mills employing natural circulation should employ it in moderation in order not to impede convection.

Mills that are equipped with an efficient recovery system have found it advantageous to cook with an acid of high free SO_2 content (over 8.0%). This practice is based on their observations that a high free SO_2 increases the rate of penetration enabling a faster temperature rise and permitting side relief to be taken earlier. It must be remembered that the stronger the SO_2 concentration in liquid and dry relief, the more efficient must be the recovery system, otherwise this practice will result in increased sulphur losses rather than a sulphur saving.

ACID-PLANT OPERATION

The importance of proper storing and handling of sulphur is very often overlooked. Sulphur received at the mill should be stored in a clean dry bin with a well-drained cement floor.

Some mills with outside storage piles estimate their wastage from outside storage at 3%. It was reported during a recent survey of ten mills that losses could go as high as 5%.

On the basis of a 3% shrinkage for a 100-ton mill burning on the average 250 pounds of sulphur per ton of pulp, this would amount to 750 pounds of sulphur per 24 hours or 7.5 pounds per ton of pulp produced.

The greatest source of loss from unprotected storage is the sulphur that is adjacent to the ground at the bottom of the pile, this sulphur becoming contaminated with dirt making it impossible to reclaim. Dirty sulphur will introduce dirt into the system and will cause a large wastage due to the frequent

cleanings that are required to keep the burner room operating efficiently.

It is realized that an enclosure suitable for storing a fairly large supply of sulphur would involve a substantial capital investment, but there are certain advantages to be derived from proper storage besides the necessity of eliminating all possible sources of sulphur loss during this critical period.

Advantages to be expected from protected storage are: (1) a supply of clean dry sulphur at all times; (2) losses from atmospheric conditions (such as heavy rains and high winds), double handling, and contaminated sulphur from the bottom of the pile are eliminated; (3) it permits a closer check on inventories.

Sulphur should be carefully weighed on a platform scale before delivery to the burner room. This scale should be in perfect mechanical order at all times. It should be cleaned and set daily, and it would be advantageous to have a set of calibration weights handy for a daily check.

Accurate records should be maintained of all daily sulphur usage. Mill personnel should be properly trained and kept informed of the progress made in combating the present shortage.

Burners should be liquid fed with molten sulphur from a suitable sulphur melting system, as dry feeding will always produce varying gas concentrations which will throw a fluctuating gas load on the stone towers, which in itself tends to permit wastage.

The burners should be operated to give a steady uniform-strength burner gas, at the same time keeping that strength as high as is possible, without running the risk of incomplete combustion and resulting sublimation. Sulphur dioxide concentration will depend largely on the equipment available. The installation of automatic controlling instruments in the burner room will aid in maintaining a uniform operation.

In order to obtain maximum burner efficiency, it is suggested that the burner be equipped with the following automatic instruments:

1. An automatic level controller for controlling the level of sulphur in the burner.
2. A recording sulphur dioxide gas analyzer which will record the actual concentration of sulphur dioxide in the burner gas.
3. An automatic damper regulator installed on the dampers between the burner and the combustion chambers.
   The sulphur dioxide recorder and damper regulator should be integrated so that as the sulphur dioxide concentration fluctuates, the gas analyzer will actuate the damper control to decrease or increase air input as needed.
4. Recording thermometers on the combustion chamber inlet and outlet.

With the above equipment available, a uniform high concentration of sulphur dioxide will be readily available.

In most mills Jenssen tower losses have more nuisance value than waste value. However, there are some cases whereby overloading of the system causes tower losses to run as high as 4%.

To help replace tower losses to a minimum, the following guides to control are listed:

1. Gas fans should not be operated at rates greater than the capacity of the Jenssen stone towers.
2. Rock in the towers should be kept clean and free of sludge.
3. Stone size should not be too small or there will be plugging or bridging.
4. Spray board or nozzles should be checked frequently in order to assure a uniform distribution of the acid or water across the entire tower area.
5. Chilled water will help absorption rates in hot water months.
6. Valves and seals must be kept in good order in order to prevent loss of gas from the strong tower.

In mills not equipped with sufficient pressure vessels for complete relief recovery, the return of over gas from the accumulator or storage tanks to the Jenssen towers can be a source of severe Jenssen tower wastes during digester relief periods. Wastes of this nature are very difficult to control and the only recommendation that can be made is that mills facing the problem should make a thorough study of their Jenssen wastes to determine the extent and value of the losses, in order to ascertain what corrective measures are merited.

Under normal operation, the concentration of SO^2 from the weak tower vent should not exceed 0.1%.

Reduction of Sulphur Trioxide Formation

The formation of sulphur trioxide in burner gas represents not only a direct loss of sulphur but also represents a definite hazard to the sulphite cook inasmuch as any SO_3 that does not unite with the stone in the tower to form $CaSO_4$ or $MgSO_4$ will remain in the system as sulphuric acid. When sulphuric acid is present in sufficient quantity, burnt cooks and damaged off-color pulps will result. It is believed, therefore, that this is one waste that every mill is striving to eliminate.

The formation of SO_3 may be prevented to a great extent by the following means:

1. The maintenance of a low moisture content in the sulphur entering the burner.
2. The maintenance of high and uniform SO_2 content in the gas leaving the burner.
3. The maintenance of proper burner temperature.
4. The prevention of oxidation of the SO_2 in the burner gas by:
   (a) Keeping the cooking system air tight.
   (b) Rapid cooling.

In respect to (1), some preference is shown for the spray-type cooler which ensures rapid cooling of the hot gas and at the same time has the effect of scrubbing out whatever SO_3 may be in the gas.

INCREASED YIELD OF PULP FROM WOOD

High yield sulphite is commonly associated with elaborate refining equipment and as such is not properly a part of this study. It may be mentioned, however, that the Pulp and Paper Research Institute of Canada have placed on their agenda Project No. R.C. 8 which will deal thoroughly with studies in high yield pulping. This project was originally suggested by the Sulphite Committee in 1947 (Project 26) but due to the inadequate funds provided at that time, the project had to be shelved.

Sufficient funds have now been made available and it is expected that the Institute will soon commence a study of this problem, which it is hoped will result in a large reduction in the amount of sulphur consumed per ton of screened unbleached pulp that will be suitable for news and unbleached grades.

CONCLUSION

Recently the Sulphite Committee of the Technical Section C.P.P.A. made a survey of the operating practices of some ten sulphite mills. This survey indicates that in most mills an immediate reduction in sulphur consumption *can* be made.

All mills are being asked, during this critical period, to do their utmost to conserve sulphur and it would be appreciated if any comments or recommendations that can be made on this subject be forwarded to the Sulphite Committee in care of the Technical Section C.P.P.A. for analysis and publication for the industry.

It is in times such as these that Necessity proves she is the mother of Invention.

With this in mind, it is quite possible that the sulphite industry, together with the cooperation of Canadian sulphur producers, may turn this period of critical shortage into a development period that will ultimately reduce manufacturing costs and will result in the birth of a new industry.

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LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel and Events

Delaware Valley

The regular monthly dinner meeting of the Delaware Valley Section was held at the Engineers Club, Philadelphia, Pa., on March 27. Prior to the dinner there was a cocktail party sponsored by paper mill suppliers. August S. Erspamer, Section Chairman, presided at the meeting, which was designated as the 20th Anniversary Meeting. Mr. Erspamer opened the meeting by thanking, on behalf of the Section, the suppliers who sponsored the splendid cocktail party, and also to the members of the committee headed by John Dieffenderfer.

Fred Lesser was called upon to give a progress report of the Albert Award. Mr. Lesser reported that to date, six papers were listed on various and interesting subjects. These papers are due, and should be in the hands of either the Secretary or Mr. Lesser by April 24. The judges for the Albert Award were announced as: John Weidner, Chairman; Walter Morehouse; and Father Malloy of St. Joseph's College.

Joe Paciello gave the report of the nominating committee consisting of John Weidner, Ben Houg, and Joe Paciello. Those nominated for 1952–53 were:

Chairman—H. C. Brill, E. I. Du Pont de Nemours & Co., Inc.
1st Vice-Chairman—Frank Lovegren, W. C. Hamilton Co.
2nd Vice-Chairman—Emil R. Padavic, Container Corp. of America
Treasurer—E. C. Molin, Glassine Paper Co.
Secretary—John Steinbinder, Riegel Paper Corp.
Executive Committee Members—August S. Erspamer, P. H. Glatfelter Co.; John P. Weidner, Container Corp. of America

J. Carl Schmidt, a charter member and devoted friend of the Section, was called upon for a few words. Mr. Schmidt commented that it was gratifying to note the tremendous progress that the Section had made during the 20 years since its inception. With pride, he introduced G. E. Landt, C. M. Connor, John Macadam, E. J. Albert, John P. Weidner, and A. S. Erspamer, who were among those who were instrumental in forming the Delaware Valley Section of TAPPI.

At this point, the Chairman introduced E. J. Albert for his talk on the "Historical Background of the Delaware Valley Section." Mr. Albert, a charter member and past Chairman of the Delaware Valley Section, has specialized in the designing and developing physical and electrical testing instruments for more than 40 years. His work has been slanted particularly for the paper industry.

Mr. Albert's talk follows:

Historical Background of the Delaware Valley Section

At the very successful TAPPI Annual Meeting in New York last month, I was particularly interested in Ray Hatch's remarks when replying to the medal presentation speech.

He said he hesitated to do any reminiscing lest people think he were an old man. Speaking for myself, I may have passed the first flush of youth, but I certainly don't think I'm old, and I will indulge in some reminiscences.

You may be interested to know how the Delaware Valley Section got its start.

During the Fall Meeting of TAPPI at Erie in 1930, Harvey P. Cannon and Charlie Revise noted that quite a number of the mills from the Philadelphia area were represented at that meeting. The next thought, quite naturally, was that if there were quite a number of TAPPI members in or near Philadelphia, that it ought to be a good idea for them to meet now and then to exchange ideas and broaden their experiences.

They mentioned the idea to the salesmen who were calling on the local mills asking them to bring up the subject on their calls to get interest aroused.

The result of this spade work was that a meeting was called to discuss the possibility of forming a local organization.

The turnout for the meeting was so good and the interest so warm; warm, I may add, in more ways than one, as it was a very hot, humid, June evening, that it was decided to form a local section of TAPPI without further delay.

The next meeting was held in September and it was at this meeting that the name *Delaware Valley Section* was adopted as well as the Articles of Organization and By-Laws. William R. Maull was elected first Chairman.

Matters progressed rapidly and in November, 1931, Max Krimmel, who was President of TAPPI at that time, personally presented the Charter to the Section.

The first few meetings were held at a restaurant over on Arch Street near Fifth Street. They had no private room for us, so they had to set up a long table on the second floor hallway, right at the head of the stairs.

That restaurant was then, and is now, set up to cater to hearty eaters, and as the draft from the kitchen and first floor restaurant was up the stairs, our discussions were conducted in a close aroma of pigs knuckles and sauerkraut, not to mention gefülte fish. This proved somewhat disconcerting to such of our members whose eating was inclined to be on the dainty side.

This dyspeptic and militant minority made such a fuss about it that Bill Maull, the Chairman, appointed a committee to find a meeting place. After a thorough search, the committee selected the Engineers Club, where we have been meeting since 1932. For several years we met in the Gold Room, which is the little room to the rear of us. When we outgrew the Gold Room, we moved down to the main dining room where we met for quite a number of years, eventually moving up here.

In those days neither the main dining room nor the kitchen were sound-conditioned. Repeatedly the clangor of dishwashing stopped our speakers cold. The kitchen help had to wash all the dishes before being able to call it a day, so speed was everything to them, and my regular job those days was to reason with the kitchen help to keep them quiet enough so the speaker could finish.

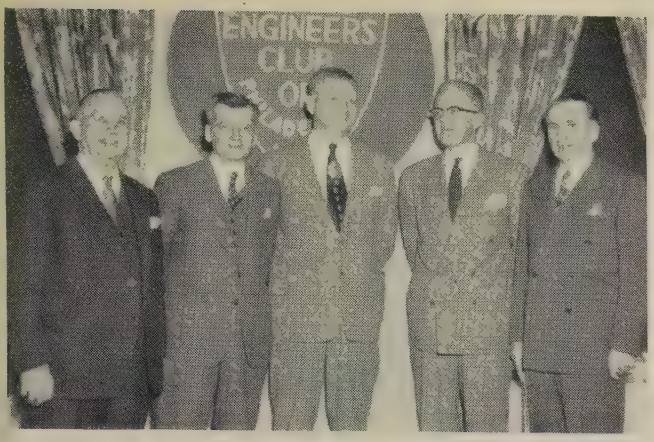
In those early days the members had no inhibitions when it came to asking our speakers questions and taking almost violent issue with them at times.

Many a time we stayed here until well after midnight listening to such colorful personalities as James d'A. Clark and Gustav Landt tear into each other on their favorite hates in papermaking. It didn't take much to get them going. They were both self-starters.

They weren't by any means alone. Harvey Cannon, Bill Shoemaker, John Halladay, Helmuth Schwalbe, and Almaron Wickham were ready at a moment's notice to swing a mean verbal shillalah on any subject and at anyone.

For the first few years I was the Chairman of the Program Committee. I needed help and got it in unstinted measure from

General view of the 20th Anniversary meeting of the Delaware Valley Section



E. J. Albert, G. E. Landt, John Macadam, J. P. Weidner, and C. M. Connor, all past Chairmen of the Delaware Valley Section

Carl Schmidt and such willing helpers as Mike Connor, Jack Harper, John Dieffenderfer, and others.

During those days we were always trying some scheme to get young men interested in the meetings. We tried holding meetings on different evenings of the week, and free beer for only those youngsters who would comment on papers. We even tried giving a technical book as a door prize, and occasionally, a free dinner for some extra effort. Then, as now, there were many things competing for our attention, such as movies, radio, dances, and even just plain laziness. However, not to be discouraged, the Program Committee has kept on trying to provide programs to encourage the interest and attendance of the younger men, to prepare these young men of today to be the leaders of tomorrow.

It has been my observation over the years that those men who were active in Section affairs and took part in delivering papers and in the discussions that followed were the ones who have progressed the most in their professions.

While we are on this subject I'd like to read you a letter from James d'A. Clark, one of our Past-Chairmen. I wrote Dr. Clark inviting him to be present at this meeting, and he has replied as follows:

"I am very sorry not to be in the vicinity of Philadelphia for the Delaware Valley Section Anniversary Meeting on the 27th. Looking back, it seemed that we had some rare discussions in the old days and it is nice to see occasionally in *Tappi* that you still have them. It is not unreasonable to consider the delivered paper being merely the lungs to aerate the blood and that the discussion period is really the heart of the meeting—especially sectional ones.

"Nowaday periodicals and trade journals are bursting with papers both good and bad, often contradictory, and the younger chaps must sometimes be sorely puzzled. Maybe an idea for a program for some meetings of a local section would be to select an interesting and worth-while topic and assign several members to review certain papers and at the meeting to summarize them briefly and debate them." Sounds like a good idea.

To make our meetings more interesting we held several joint meetings, two with the Graphic Arts Society and several with the Superintendents Association. One of the meetings with the Graphic Arts Society was quite a pretentious affair. It was a combination effort of papermakers, ink men, printers, and commercial artists. We had an exhibit of various kinds of papers and also completed posters. This exhibit ran for two days and two evenings. The attendance was very good.

Our first meeting with the Superintendents Association, as near as I can remember, was in 1933 or 1934. At that time a great many people were still unemployed and in need. The main feature of this meeting was a debate on some form of economics between a representative of the Superintendents Association and Dr. Landt representing us.

Dr. Landt opened his talk with "Brother, can you spare a dime?" His delivery was so sincere, and his need apparently so great that a couple of the boys immediately passed the hat. I heard some dimes clinking, but I don't know to this day how much Doc made on that deal. All those joint meetings were very successful. We ought to plan to have them more often.

Our first big job as a Section was when we were told by the Executive Committee of TAPPI that we were "volunteering" to sponsor the Fall Meeting of 1935. I'll never forget the meeting when we got that news. We were the sorriest looking set of volunteers you ever saw. Our first and almost automatic reaction was to thank them for the compliment and beg to be excused. However, sounder counsel prevailed in the end and even after the lapse of so many years, I'm still impressed with the competent way in which Bill Maull, who was made General Chairman, took charge and handled things.

It was the old story of breaking a job into small enough pieces and getting everyone to take care of a piece. The membership, once it was decided to go ahead, was wonderfully cooperative and every last member of the Section had a job on the Fall Meeting Committee. It was decided to hold the meeting partly in Philadelphia, but mostly in Atlantic City. We had no money to do anything, and how to get money was a major problem. Remember, this was in 1935 with the country barely crawling out of the depression. We decided to put the "bite" on the suppliers by publishing a program and selling them advertising space in it. We also sold exhibition space to the machinery and instrument makers. Neither job was easy but we managed it, making a 56-page program, size 9 by 12. We sold 39 pages of advertising to a total of 66 advertisers.

Bill Maull, who was Manager of Dill and Collins, couldn't do anything else but contribute the paper for the program, and Hugo Hanson of W. C. Hamilton and Sons, the cover stock. Somehow or other we just couldn't get any printer to do the job free, so we did have some expenses, but in the final accounting we did very well. We managed to lay aside $2000 in our reserve fund. Knowing that we had this gave us a very comfortable feeling in after years at such times when our operating expenses exceeded our income. Of course, this nest egg was a tangible sign of progress, but a far greater benefit was that after that 1935 Fall Meeting we were really a going section; a well-knit whole rather than an occasional gathering of a lot of individuals.

None of the Committee had ever had any experience in putting on a meeting of this kind, so we played strictly by ear. Among other of our ideas was to put on an amateur theatrical performance during dinner at this meeting, as a token of appreciation to the suppliers and the advertisers for their grand support. It was called the "Gay Nineties Party." In a group the size of the Committee there are always "Hams" who like to perform. Our crowd was no exception and soon the cast was rehearsing.

I forgot to mention that not only did we have a number of enthusiastic amateur actors, we also had a playwright. I don't recall who he was, but I do know that we all thought he was great. Everything went along fine and I remember how excellently the final rehearsal came off. The first act depicted a distracted housewife surrounded by her hungry children waiting for her drunken husband to come home before they could buy food. The chap who played the drunken husband was a perfectionist. He knew his own lines letter perfect and he also knew everyone else's lines. Incidentally, he was a teetotaler.

Well, time passes on and then came the evening for the show. Our hero, familiarly known as "Skinny," was, as I have said, a perfectionist, and wanting to put the last artistic touch to his performance stopped in at the Ambassador Bar to get a drink and so complete the picture. Now can you imagine a teetotaler in such circumstance braving a bar filled with papermakers and suppliers? But they were kind to him—too kind, and when it came time for the show they saw to it that he was in the wings awaiting his cue. His cue came, and speaking his lines: "My wife, my poor, dear wife," he staggered on to the stage. The burst of applause that greeted him may have done something to him. At any rate, he fell on his face and fell asleep all at one time.

The audience rose and pelted the players with half-eaten buns and chased them off the stage. And so ended our first and only venture in theatricals.

I seem to have dwelt on the financial results and the lighter side of the Atlantic City meeting, but the technical program was prepared with care and the meetings were of high order. Looking back over the program, I would say it would compare very favorably with any present-day meetings. The attendance at the meetings was very gratifying.

During the war most of us were working long hours as we were all on war work of some kind, but the attendance at our meetings was surprisingly good; even though our discussions were cramped by secrecy requirements. I remember this well, as during part of the war I was Chairman of the Section and found it a tough problem to keep discussions lively without running into these secrecy walls.

During this period the draft boards were reasonable about deferring young technical men, but we lost one of our active, enthusiastic members, Ronnie Atwater, who was called to Washington to head a section of the War Production Board. Another was Fred Streicher, who was a reserve major of cavalry. He was called to active duty, and still is with the Army in Germany.

While our meetings are usually on the serious side, for a number of years we celebrated the end of our season's work by a golf meet and dinner dance in June. Due to the food restrictions during and immediately after the war and the rapidly mounting costs, we stopped having these parties. They were an excellent medium for getting closer acquainted. We ought to consider reviving this

custom again on this, our 20th Anniversary. Maybe wives would be more agreeable about our attendance at our regular meetings during the year if we had a bang-up party each year to close the season's work.

I have tried to keep from quoting figures, but before closing I thought you might be interested in hearing a few of a general nature. During the past 20 years, the production of paper and paperboard in the area covered by the Delaware Valley Section has tripled, not in inflated dollars, but in tons of product. During this same time, the membership of national TAPPI increased fourfold and the membership of our Section increased fivefold.

Here is another interesting item. This Section has had 13 Chairmen in the past 20 years. They must like the Section because six of them attend meetings regularly, and of the 57 members on the rolls in 1931–32, 20 still attend our meetings with fair regularity. A Section must have something if it can sustain interest over such a long period.

And finally, I want to pay tribute to R. G. Macdonald, our genial Secretary-Treasurer. For the past 20 years his wise counsel, his never failing optimism, and his encouragement have always been of great help to us.

On this 20th Anniversary, the present members wished to express their appreciation to the Past-Chairmen of the Section, and as a small measure of the Section's esteem for these men, Chairman Erspamer presented a suitably engraved desk pen set to each of the Past-Chairmen present. Those receiving this gift were Dr. Landt, C. M. Connor, John Macadam, E. J. Albert, and John Weidner. The Past-Chairmen unable to be present will receive their pen set by mail.

Chairman Erspamer then introduced R. G. Macdonald, National TAPPI Secretary, who briefly congratulated the Section on its 20th Anniversary, and commented on the fine progress it had made.

The Chairman then turned the meeting over to Harold Brill, Program Chairman, who introduced the main speaker of the evening, K. P. Geohegan, President of National TAPPI. Mr. Geohegan's topic was "Development of TAPPI and the Local Sections."

Mr. Geohegan's talk follows:

Development of TAPPI and the Local Sections

This is the second time that I have had the pleasure of attending one of your meetings; and I am particularly glad to be here tonight, as it gives me an opportunity to talk about something that I feel is important to the success of TAPPI.

There could be no more appropriate occasion than this 20th Anniversary Meeting of the Delaware Valley Section, as I am convinced that the successful development of TAPPI depends primarily upon the successful development of the local sections.

When TAPPI was founded in 1915 with 35 members, these men foresaw the need of the paper industry for an organization for broadening our knowledge of papermaking. However, they could hardly foresee an organization that would grow to more than 5000 members with 10 local sections, 50 committees, and 90 subcommittees. They realized even then the need for local sections but they could hardly foresee the essential part they would play in an organization of that size.

The development of TAPPI has been an amazing one in many ways besides its mere increase in size. In this connection I would like to read you a statement that appeared in a New York paper, *The Journal of Commerce*, in 1917, two years after TAPPI was founded.

"Altruism and cooperative fellowship evidently permeate the paper industry, as they do in some other business organizations. Here are men of international reputations as experts, occupying responsible positions with the largest concerns, freely giving their competitors and the industry in general the benefit of their experimentation and learning, not for selfish gain, but for the common uplift of the entire industry. And in some cases it has a distinctly patriotic tendency."

It is remarkable that this same attitude has continued to this day and that those who serve TAPPI whether it be in the local sections, the various committees, or as national officers do so entirely because of their regard for the Association and because of their appreciation of the services that it is rendering to the entire industry.

Our phenomenal growth is conclusive evidence of a sound policy and is something of which we should be very proud; but at the same time, it has brought with it problems that must be faced if we are to continue to build on as sound a basis as we have in the past. Some of these problems are obvious to all of you; some can be recognized only by those who have been struggling with them. It is in the solving of these problems that I feel the Delaware Section and the other local sections must play an important part.

For example, every one of you who attends our February Conventions realizes how crowded our programs have become. The separation of our Fall convention into a group of functional meetings has helped; but they are growing in size so rapidly that they, too, promise to become overcrowded.

Then, where does the solution lie? It must be in more frequent meetings of our committees and, even more, in strong meetings of our local sections. To get some idea as to how our committees and sections may develop, let us first consider TAPPI as a whole, and how it is organized.

As you know, the continuity of our organization is furnished by our Secretary, Mr. Macdonald and his staff of assistants. It is almost unbelievable that Mr. Macdonald was able to add to the duties that he already had, the editorship of *Tappi* and was able to develop it to the outstanding magazine that it is. In addition to bringing to all of the members technical papers of the highest caliber, edited by a board of experts, it is providing a medium wherein the news and activities of each local section is carried to the others.

To assist Mr. Macdonald and his staff and to share the responsibilities of determining over-all policies, we have an Executive Committee consisting of 12 members in addition to the President and Vice-President.

The term of office of each man on this committee is for 3 years, with the exception of the President and Vice-President, who are chosen yearly. These terms are staggered so that each year four executive committee members are elected. The names to be placed on the ballot are selected by a nominating committee and are based on certain essential considerations.

First, it is important that the Executive Committee represent TAPPI geographically and that all sections of the country be uniformly represented. One is usually chosen from Canada to keep close bond between us and our brothers across the border. Second, it is important that they represent all segments of the industry. Third, they must be men with a willingness to work and preferably with experience in TAPPI as an officer in one of the local sections or through membership on one of the committees. Fourth, they must be men whose positions permit them to travel and to attend the Executive Committee Meetings that are held throughout the year.

I would like to say that my work on the Executive Committee has been one of the greatest inspirations that I have ever experienced. Here is a group of men traveling long distances and sitting through long arduous meetings, arguing about what they feel is best for the future of TAPPI, but never with any selfish personal interest. Their loyalty to TAPPI for its own sake, is evidence of the value of what TAPPI is doing.

Each member of the Executive Committee is assigned by the President as representative to one or more of the local sections and it is his responsibility to bring closer together the work of that section and the work of the national organization. In a similar way members of the committee are appointed to lead the activities of the various divisions; and I would like to express my appreciation of the wholehearted way in which members of the committee have undertaken the leadership of divisions with which they were totally unfamiliar and even though this work was not of their choosing and held no particular interest for them.

One of the functions of the Executive Committee, and one for which its members have a deep feeling of responsibility, is handling the available funds. The Executive Committee realizes that these funds really belong to the members of TAPPI, and they have been exceptionally conscientious in not spending them without careful consideration that they should bring to the members the greatest possible return in services or in added information.

For this purpose, there has been formed a Research Appropriations Committee consisting of a Chairman and ten members. The President and Vice-President of the Association are members automatically; the rest have been chosen from the industry because of their broad knowledge of research. Appropriations for research are not made without the approval of this committee; and in order to expedite appropriations that are urgently needed; this committee has the power to make appropriations not exceeding a fixed amount, providing the committee is unanimous in its approval. If even one member dissents, the question must be brought before the Executive Committee.

A request for such appropriations must originate in one of the committees, have the approval of its Chairman, and then the approval of the Divisional Chairman who transmits a formal request giving all of the pertinent information to the Chairman of the Appropriations Committee.

This machinery sounds clumsy and as if it would take a long time; but in spite of the protection that such a procedure affords, it requires only two or three weeks from the time the request is received by the Chairman of the Appropriations Committee, providing, of course, that the request is of such a nature that the committee approves of it unanimously. This committee has been functioning very smoothly and efficiently.

H. C. Brill, E. I. du Pont de Nemours & Co., making presentation to K. P. Geohegan, Howard Paper Mills, Inc., President of TAPPI

It is when we consider the work of our divisional committees and of our local sections, we see the possibility of improvement to solve some of the problems that are the result of TAPPI's growth.

We have already mentioned the crowded condition at our February Conventions. It is impossible to attend all of the sessions that interest us; and at each session there is not time for a satisfactory discussion of the papers that are presented. The time that can be allotted to committee meetings is insufficient to prepare an adequate program for the coming year. Many members find conflicts between the committee meetings they should attend. Our functional meetings offer a partial solution, but they are not sufficient. It seems to me that our local sections may furnish the answer.

In making the suggestions that I am about to propose, I am not in any way criticizing the activities of the local sections. They have been doing magnificently. Their attendance has been better than ever before; and their meetings have been more interesting. However, I feel that we can go still further in making them more valuable to their own members as well as to the national organization.

Again, I would like to make an explanation. When I speak of the possibility of the local sections helping the national organization, I am thinking of aid to the entire TAPPI membership; for after all the function of those in our offices in New York is to coordinate the activities of TAPPI in such a way that all of the members will benefit. Here, our new magazine has been reporting to the entire membership the activities of each section and bringing to everyone the information that is gained through the local section meetings. Without this, the suggestion that I am about to make would not be valid.

It seems to me that in order to alleviate the crowded situation in our February sessions, more of the papers presented at the local section meetings should be on the level of those that we have been presenting at our National Meetings, and should qualify for submission to our editorial board to be included in the technical section of *Tappi*. If possible the discussion of these papers should be published.

I have always felt strongly that often the discussions that follow a paper are more important and more illuminating than the paper itself. In this the local sections have an advantage, as the time for discussion is less limited.

I wish that all discussions of this kind could be published so that all members would have the advantage of reading them. Of course, there is an objection to this in that many hesitate to talk when they know that what they say will appear in print. They feel that they may be misquoted and that someone will get a false impression of what they said. Perhaps the solution is to make sure that each man who speaks is given an opportunity to edit his remarks and to delete anything that he does not wish to appear in print.

Here, then, is an opportunity for the local sections to help the situation nationally and at the same time give added importance to their own meetings. By presenting and discussing the type of papers that formerly have been given only at the national meetings, and by submitting these for publication in the technical section of *Tappi* subject to editing by our Board, they can relieve some of the congestion at the February Meeting with no loss to the members of TAPPI.

Now, let us consider our committees. Many of them are functioning extremely well, but many are not taking full advantage of their opportunities. Why? I believe that it is because it is difficult to carry on the work of a committee by correspondence when there is only one or two meetings a year.

Each local section has certain types of pulp and paper mills and allied industries situated in its locality that make that section particularly well suited for studying certain problems. Already, the work of some of our committees is being centered in such local sections, and these committees are operating well.

It would be helpful if more of this could be done, thus giving the committee members a chance to meet frequently during the year. Ideas for worth-while papers and for studying new problems can best be developed by the kind of discussion that follows when a small group of men sit around a table and air their views freely.

If all our committees had at least one half their members living near enough to each other that they could meet frequently, they would make more progress. Members who were too far away to attend frequently could be kept informed by correspondence and their comments would keep the committee from becoming too local in its views.

Summarizing, it appears that the local sections can do much toward solving two important problems of TAPPI that are the result of its growth. They can relieve the congestion at our National Meetings by better papers at their own meetings, and by arranging for their publication in the technical section of *Tappi;* and they can serve as centers of activity for our committees.

Obviously, a program such as I have outlined is not something that can be accomplished overnight. Rather, it is a definite trend to be followed over the years. I feel that it points to a way in which the local sections can become stronger and at the same time furnish the outlet that national TAPPI needs for its continued growth.

After this fine presentation, there was a short discussion period. Harold Brill then presented Mr. Geohegan with an engraved desk pen and pencil set as a token of the section's appreciation for his being with us on our 20th anniversary.

The last presentation was a pen set to the present Chairman, August S. Erspamer.

Donald H. Newcomb, *Secretary*
Delaware Valley Section

Ohio

The Ohio Section held a dinner meeting on Jan. 10, 1952, at the Manchester Hotel, Middletown, Ohio. One hundred seventeen members and guests were present. Chairman H. A. Smith presided.

Chairman Smith announced that the Ohio *News-Letter* would be continued for the balance of the year. He urged members to cooperate with the editors by submitting information pertaining to the section's activities or members.

Program Chairman, John Clouse, introduced the speaker for the evening, Paul Cope, of the Procter and Gamble Co., Cincinnati, Ohio. Mr. Cope spoke on the subject "Paper

H. C. Brill with a token of appreciation for A. S. Erspamer, P. H. Glatfelter Co., Chairman of the Delaware Valley Section

Packaging." He presented case histories of problems encountered by the consumer of paper packages. He concluded with an outline of the predicted future progress for the paper package.

Following Mr. Cope's talk the film "The Magic Box" produced by the Folding Paper Box Association was shown through the courtesy of the Gardner Board and Carton Co.

Mr. Cope's talk follows:

Packaging

Approximately 6 billion dollars are spent on packaging materials each year. Packaging has been described as the conveyor belt that carries the product from the manufacturer to the customer.

Packaging means different things to different people. Just for a moment place yourself in each of the following people's places and see what your feelings are:

1. The artist who designs the appearance features of the package.
2. The man who must match the colors.
3. The printer who must hold color, printing clarity, and registration.
4. The packer who must fill these packages.
5. The warehouse man.
6. The storekeeper.
7. The customer.

This is only a partial list, but your reactions must have changed as you shifted from one viewpoint to the other.

Tonight I am going to talk about the kind of packages we use at Procter and Gamble, because they are the kind I know the most about. They include such things as bottles, jars, closures, collapsible tubes, flexible films, cans, drums, coatings, inks, and the many-paper products such as cartons, corrugated containers, labels, wrappers, and tissues.

Tonight we will confine our discussion to the subject of developing and the writing of specifications for a package. The idea will be to give you, who make packages or materials that go into the making of packages, a chance to see why certain things are necessary.

Most of us can remember when many items were sold in bulk, potatoes, beans, flour, sugar, and the like. They were the basic materials from which you as the customer made the finished product. Packaging for the most part was simple. The package had to be physically strong enough to hold the product. There was little need for doing anything else.

Today it is possible to buy most anything in a package. In many cases the products are finished products ready to use, or semifinished products that require little additional work to make them ready to use. For instance, you can buy frozen French fried potatoes, prepared cake mixes, materials for a home permanent wave, frozen orange juice, tea in a bag ready to use, and many others and more coming all the time.

Packages for many of these items must be tailor-made so the product will have a shelf life long enough to make it economical to pack, ship, and sell the product. Many ways have been found to prolong shelf-life, allowing products heretofore impractical to package to become commercially packagable.

We will come back to this later for more detail, but first let us get a little broader picture of packaging. You may say let's start at the beginning. Alright—how do all these products and packages get started? Broadly, they come about in two ways. First, someone finds a way of making a product that they feel people will buy and then they try to sell it or they recognize a need for a product and develop it. In any case it must be sold, the job of the advertising and sales people. Therefore, the advertising and sales departments fix the size of the unit to be sold. They will be very conscious of the color of the package, the size and shape of the package, and any other feature that is important to their customers such as ease of opening, etc.

Today to remain competitive we must all produce at ever increasing rates to get our costs down. This means that the packages must be such that they can be made and packed on high-speed automatic equipment in many cases.

Many products are sold nationally and must be packed weeks and months ahead of the time they are finally used. In addition, they may need to be shipped long distances in all kinds of temperatures and humidities. A product to survive must continue to arrive, time after time, in good condition. Here is where the package often plays an important part. Careful testing is often required to find a satisfactory package, and even then that is often under constant study in an effort to improve on it.

When such a package has been developed, specifications are written. We try to write specifications so that they cover only those things that are important to us, and give our suppliers options wherever possible. To give you some of the more colorful stories behind certain specifications you may run into from time to time I will tell you some true stories, but fortunately they did not all happen to us.

In some sections of the country lard and vegetable shortening are commonly sold in cartons. The package is a Peters-style carton with a greaseproof or parchment liner. One packer was getting a number of complaints about rancid stock, and on investigating found that all stock packed during one period was rancid. Further investigation showed that the greaseproof-liner was causing the trouble. Further tests showed that the greaseproof sheet contained traces of copper, and copper, even in trace quantities encourages rancidity. It was finally found that the paper mill had been having slime trouble and the mill, to help reduce the slime, had added some copper sulphate to the pulp in the chests. So today it is common practice to test for copper in papers used in contact with foods containing fat.

Another paper mill had been making a sheet for a customer for a number of years. This sheet, too, was against the product. Through much effort over the years they had produced this sheet quite white in color and they were very proud of it. Then along came the war and chlorine was curtailed and they were forced to reduce the whiteness of the paper. Everything went fine until one day a warehouse inspection showed some of the packed product turning blue. Here was a white paper on a white product and the product turning blue. Did the paper contain dye? The supplier said no, but the color persisted. Finally an alcoholic extraction was made of the paper and out came the dye. The supplier was called in; when he saw the blue product and the blue extraction he said he only put in a small amount of dye to raise the whiteness of the paper. When he realized what he had done he took the dye out and the trouble was over.

One time a blue package in the stores was developing brown spots that looked like rust spots. There was no apparent cause for the stains. However it was noticed that it only occurred on one supplier's packages for that product. A few screening tests indicated that the brown stain could be reproduced by a drop of dilute acid. This soon brought out the fact that the ink was made of ultramarine blue, cadmium yellow, and carbon black. The ultramarine blue, being acid sensitive, bleached out leaving the cadmium yellow and carbon black behind to look like a rust stain. By holding the pH of the paper above the critical pH for ultramarine blue and backing up the ultramarine blue with another blue that was not acid sensitive, the trouble was eliminated.

One time we were conducting some blind tests with a lightly perfumed soap, so we got some unprinted wrappers for the survey. The soap was wrapped and stood around for a few days before the survey could be made. One of the fellows unwrapped one of the bars and had it lying on his desk where he was working. Much to his surprise, the white bar began to turn pink. Imagine the commotion that caused. A test bar about to be surveyed turning pink. Some exploratory work showed that the wrapper used had a slight odor which was identified as pentachlorophenol. Later it was found that pentachlorophenol and certain perfume ingredients would develop a pink color when exposed to sunlight for a short time. This opened up a whole series of tests which indicated a number of dos and don'ts for soap wrappers.

During an abnormally wet Summer, a few years ago, certain kinds of soap cartons were found discolored on the grocers' shelves. Cartons from different suppliers discolored in different ways on the same product. This problem was a little confusing at first, but it was soon found that whenever a color faded it was sensitive to alkali. How was the alkali getting to the ink in the trade? Well, the humidities were high enough to cause a continuous phase of moisture in the board. The moisture was working its way in from the outside. When it reached the soap, the latter began to dissolve in the moisture and worked its way back through the moisture to the ink. Soap, as you know, is on the alkaline side and immediately attacked those inks that were sensitive. We knew that this was happening because when the board would dry out a small residue of soap could be found on the surface of the carton. By exaggerating our condition, results could be reproduced in a matter of a few hours. When the suppliers knew the cause of the trouble, they used alkali-resisting inks and the trouble ended.

Another case stands out quite clearly in my mind. We had been using cadmium yellow on one of our packages for many years with no trouble in the trade. For some reason someone put a number of these packages in a glass jar and closed it up tightly. This just remained in a room for nearly a year. When the man got around to examining the samples he had set aside, he noticed that the yellow on some of the packages had completely disappeared. He called me in to see what had happened. Close examination showed that only those yellow places exposed to light were faded. Examination of the literature showed that cadmium yellow in the presence of moisture and sunlight will fade. The high humidity in the closed jar and the sunlight did the trick.

With no trade complaints in many years of use, we dismissed the incident with little more than a mental note of what had hap-

pened. All was fine until we began shipping to the Philippines. The complaints began rolling in. We immediately suspected what was causing the trouble, but try as we would, we could not reproduce this trouble quickly. Finally after many attempts, we placed a printed sample in a test tube with a damp piece of blotting paper and then corked up the tube and hung it in the fadeometer. In two to three days the cadmium yellow faded. We still had not solved our problem because none of the other commercially available yellows were as good as cadmium yellow. The case was beginning to look almost hopeless and we were beginning to consider colors other than yellow when, by chance, a research man from one of the pigment manufacturers stopped in to see us about another problem. We asked him if he had any new yellow pigments under development. He said that the yellow Cadillac with the leopard skin seat-covers then being featured in national advertising used a new yellow pigment that might do the job. Test samples did stand up and that is the pigment we use today for this particular job.

There are many more stories like these that I could tell, and they are not all confined to paper and paper packages, but I thought that those pertaining to paper would be of the most interest to you. I have told you these stories to illustrate some points which can be summarized as follows:

1. To show you how some of the tests that you sometimes have to meet originate. They are tailor-made to fit a given need. These tests should not be used blindly, because they have no meaning outside of some specific situation.
2. To show you how it is possible to produce far-reaching complications by what may seem to you to be a very innocent change.

When you, as suppliers of packaging materials, make changes in your product the safe thing to do is to make certain that the change does not affect your customer. Packages are becoming more and more tailor-made to do a given job. Even the slightest alteration sometimes will make them ill-fitting.

A change in the moisture absorption of a sheet may change the rate at which a package can be glued. High-speed equipment today in many cases is running so near the critical point that these changes can be detected.

Even the slightest change in dimensions can sometimes affect the way a carton will form or tuck.

A change in pigments may cause fading or bleeding, and those things you may add in small amounts may be a mold food under some conditions, or they may act up in some other unexpected way.

When receiving samples for examination or approval, we like to have them identified by some name or number so that the samples can be reproduced in production if we find we need them.

I want to leave with you the feeling that changes that are improvements are good and are welcomed, but make sure they are improvements to all concerned before you go too far.

What kind of improvements will packers be looking for in the days to come? One thing will be uniformity. As I have already said, when speeds increase, the things that one time were minor differences become real differences. These can mean the difference between good operation and poor operation. By uniformity we mean uniformity of printing surface, uniformity of stiffness, folding, gluing, and the like.

Packaging will be looking for better and better functional properties such as greaseproofness, moldproofness, moistureproofness, wet strength, rigidity, and many others. Some of these will come about by new materials entering the field such as P.V.A., polyethylene, saran, melamine, silicone, and a long list of others used in combination with paper to give a needed characteristic for some specific job.

Packers are continually looking for new materials they can use to do specific jobs. The selection of the materials they use will be governed in the most part by factors such as cost, availability, appearance, and how well it does the job it is intended to do.

Meeting of Feb. 12, 1952

The Ohio Section meeting of February 12 was held at the Manchester Hotel, Middletown, Ohio, with 147 present. Chairman Herb Smith presided. This meeting was on the subject of "Routine Testing Controls." Ed Brandon and Harold Koch were Chairmen of the committee in charge of the program.

Prior to the dinner meeting the following companies had demonstrations and displays of testing equipment: Central Scientific Co.; E. J. Cady & Co.; Gardner Laboratories; Hercules Powder Co.; Herman Manufacturing Co.; Hart Moisture Meters; Macbeth Corp.; Moisture Register Corp.; Photovolt Corp.; B. F. Perkins & Sons.; Industrial Nucleonics; Thwing-Albert Instrument Co.; and Tracerlab, Inc. Also, A. J. Palladino of the National Council for Stream Improvement presented two lectures and demonstrations on the B.O.D. testing procedure.

The program following the dinner was devoted to the presentation of the results of the questionnaire previously submitted by the Section Testing Committee. Mr. Koch summarized the 9 new routine control testing procedures submitted. Mr. Brandon summarized the data of the testing questionnaire.

The abstract of the routine testing procedures submitted and the summary of the testing questionnaire follow:

1. *Repellency Rating for Treated Papers.* A drop of water is allowed to roll down the paper sample held at a 45° angle. The characteristics of the wet trail determine the numerical rating of the water-repellent treatment.
2. *Test Method for the Determination of the Presence of Converted Tub Size Starch in Paper.* The usual method of spot testing a sheet surface by applying iodine solution in order to identify starch tub sizing is not always accurate. A different method which has been found reliable is suggested.
3. *Viscosity Measurement of Starches; Correlation Between Dudley Pipet and Zahn Viscosity Cup.* The Dudley pipet frequently used for routine control of enzyme conversion has a number of disadvantages. Preliminary work indicates that it is possible to use the Zahn viscosity cup in place of the pipet.
4. *Dirt in Pulp.* A suspension of the pulp sample is prepared under standard conditions and is made into handsheets formed on filter paper in a Buchner funnel. Dirt specks in these handsheets are counted with transmitted light and reported as specks per gram of pulp.
5. *Bleachability of Old Paper Pulp.* A measured sample of slush pulp is treated with an excess of bleach liquor of known strength. After a definite time, the excess chlorine is back titrated with standard sodium thiosulphate solution.
6. *Determination of Per Cent Air in Paper Stock.* A sample of low consistency stock is siphoned from the machine headbox or other points into a special pipet. The difference in weight between this sample and that of a similar boiled sample is a measure of entrained air which can be reported in per cent by weight.
7. *Determination of the Sieve Residues Content of Clay.* A slurry of clay of known concentration is run through a 325-mesh sieve. The residue retained on this sieve is washed through a series of three smaller tared sieves having wires of 80, 170, and 325 mesh, respectively. The weight of the dry residue retained on each is reported as a percentage of the sample.
8. *Casein Viscosity.* Fifty grams of moisture-free casein are cut with the same proportion of chemicals and at the same temperature as used in the mill. The casein solution is diluted to 500 ml. and viscosity determined at 21 °C. using a Dudley pipet.
9. *Foam Stability of Casein.* Three hundred ml. of the casein solution prepared for the viscosity test are agitated in a Medco mixer and transferred to a 500-ml. graduate. The time required for a portion of the foam to disappear in the graduate is a measure of the casein's foam stability.

These methods were submitted by the following individuals:

Method 1.	Charles F. Hill, The Sorg Paper Co. (This method is suggested in a du Pont bulletin.)
Method 2.	John L. Clouse, Oxford Miami Paper Co.
Method 3.	Same.
Method 4.	Herbert A. Smith, The Mead Corp. (This method is being studied by the Pulp Testing Committee of TAPPI.)
Method 5.	Same.
Method 6.	Same. (A similar method appeared in *Pulp & Paper Magazine of Canada*, April, 1951, by R. Smith, G. Hughson, and R. Duncan.)
Method 7.	K. F. Miles, The Mead Corp. (This method is being studied by the Testing of Clays Subcommittee of the Nonfibrous Materials Testing Committee of TAPPI.)
Method 8.	A. C. Groom, The Mead Corp. (This method is an adaptation from one appearing in a bulletin published by Hercules Powder Co.)
Method 9.	Same.

Remarks by C. F. Brandon

PAPER TESTING QUESTIONNAIRE

In February, 1948, the Ohio Section conducted a survey of the mills in this district to determine what tests were being made. That survey covered tests made on raw materials and tests made in process as well as tests made on the finished paper. This year your Program Committee decided that another survey should be

made of the testing procedures used but this time only tests on finished paper would be included. This survey has been made, and each of you has been given a summary of the results.

The questionnaire was sent to all mills in this territory, and replies were received from 19 mills. Ten of these were fine paper or specialty mills and 9 were coarse paper, board, or straw mills. The first 7 questions cover general information about the mills and the amount of testing done and are basically the same questions as were asked in the previous survey.

An attempt was made to compare the testing now being done with that which was being done 4 years ago, but this comparison was very difficult to make as some mills which answered the 1948 Questionnaire did not answer this one. However, in general, it appears that there has been an increase in testing in most of the mills covered. The increase in testing is also demonstrated by the fact that only one fine paper mill reporting does not now have 24-hour control, and over half of the coarse paper mills now have 24-hour control. A number of the coarse paper mills reporting in 1948 did not even have a laboratory. Replies also indicate that a greater percentage of the mills doing testing are now making the tests in a humidity room.

All of this indicates the increasing value being placed on paper testing, and the importance of good testing procedure. I am sure that all of us are making some tests with which we are dissatisfied and, in many cases, someone else in making this test in a more satisfactory manner. We have already received much valuable information from the B.O.D. demonstrations given by Mr. Palladino and by the many demonstrations of testing equipment given by the various manufacturers' representatives which are present. It is hoped that as the program continues we will be able to obtain help on some of our other testing problems. However, this can only be accomplished if everyone enters into the spirit of the discussion, asking questions when you have them, and volunteering answers to those questions which you are able to answer.

If you look down over the summary of question 8, you will note that a few tests such as weight, moisture, caliper, bursting strength, tearing resistance, brightness, color, finish, and formation are regularly measured by more than half of the mills reporting while a number of others are made by only a very few mills. In general, we shall attempt to discuss those tests which are made most frequently, but if any of you have any questions about the less frequently made tests, we will attempt to get answers for you.

It will also be noted that when a TAPPI Standard procedure exists for a test most of the mills making this test use either the TAPPI Standard procedure or a slight modification of this procedure and, in most cases, the majority of the people answering the Questionnaire are satisfied with the tests. There are a few outstanding exceptions to this.

Finish

The problem of testing finish seems to be a good one with which to start our discussion of paper testing. Eleven mills regularly test finish and two others test it occasionally while only four report that they never make this test. Nine mills also indicate that they make smoothness tests and seven make gloss tests. Only two people indicated dissatisfaction under the general category of finish, but six indicated dissatisfaction with the smoothness test and no one checked the gloss tests as satisfactory. The Bekk tester is the one most commonly used for smoothness, but it is no longer on the market; therefore, there is bound to be dissatisfaction from specifications written on an instrument which is no longer available. One mill also reports that they feel the Bekk instrument does not correlate well with printing smoothness, especially with sheets treated for gloss inks. There is also a feeling that the area tested is too small and that too much time is required for controlled tests.

Six mills used the Ingersoll Glarimeter for measuring gloss, and all but one considered it unsatisfactory. That one mill did not mark that portion of the questionnaire. Have any of you located a tester which seems to give more satisfactory results or are there any tricks to operating these to make them more reliable? *Now, we would like to have comments from the group on these tests.*

Degree of Sizing

A variety of tests are made in measuring the degree of sizing, and I doubt if any of us are completely satisfied with our tests; although, only five people marked that they were dissatisfied. Two mills use penescope, one uses Valley size tester, one a Cobb size tester, and two use homemade equipment. Two mills use the dry indicator method, one uses a special acid ink, and one uses T 432. The mill using the acid ink mixes 10 ml. of glacial acetic acid with 100 ml. of Waterman's fountain pen ink and reports, "results correlate exceptionally well with the amount of size used in the beater." One mill considers the dry indicator method far superior to the ink flotation test and states, "The furnish affects the results on the courier size tester and the ink flotation tests." One mill reports the procedure for soaking the sample in water until the tensile strength reduces to a certain point. The time required to reduce to this point is a measure of the degree of sizing. A mill using the water drop test reports that the test measures too small an area and does not correlate well with troubles encountered in gluing.

Pick

Pick is another test which is made by a large proportion answering the questionnaire. Four mills expressed dissatisfaction with this test. The general feeling among the mills commenting was that the results did not agree with the results obtained on a press.

Moisture

Only two mills reporting do not check for moisture, and a variety of testing procedures are used. There seems to be a general desire for an electric method for measuring moisture because of the time required for a gravimetric test and the chances of error if the test is made by inexperienced help. Five mills have used Hart Meters and one a Moisture Register. I am sure we would all like to receive any *comments we can on the use of this equipment.*

Folding Endurance

Only eight mills make this test, but three of these eight consider it unsatisfactory. There is a general feeling that the test is not sufficiently reproducible.

Color

Three people expressed dissatisfaction with color, mostly because of the personal factor present in the method used. Of course, this can be eliminated with electrical equipment, but the cost is very high.

Dirt

Again, three people expressed dissatisfaction with the method used because of the human element present. One mill gave its procedure for making dirt counts on paper.

Other Tests

Other tests on which two mills reported dissatisfaction are: bending, scoring, brightness, formation, curl, and oil penetration. At least one mill in the section is dissatisfied with each of the following tests: caliper, filler analysis, tensile stretch, softness, erasure, scuff, blocking resistance, pin holes, fading, accelerated aging, pH, coating pickup, oil absorption, shrinkage, splitting, and flammability.

New Tests Needed

Under the heading of "New Tests Needed" have been listed such items as:

1. Extension and clarification of tests used to evaluate wet strength papers.
2. Development of better size test.
3. Development of a fast and accurate moisture test.
4. Clarification of the tensile testing procedures.

Questionnaire Details

Following is a detailed report of the responses to the Ohio Section Questionnaire on Test Methods:

The questionnaire was a continuation of the one sent out to the mills in the Ohio Section in December, 1947. At that time, a survey was taken of the mills in this territory to determine what tests were made on raw materials, on stock in process, and on finished paper. It was decided that this survey should be continued to find out how these various tests were made, but this time only tests on the finished paper should be considered. The tests included in this questionnaire were those which were reported to have been made by someone in the 1947 survey, and spaces were provided for any additional tests that might be made.

The most important part of this survey were the comments listed under "Question 12." It was requested that comments be made on as many tests as possible. The comments were to include a brief description of modifications of TAPPI Standard tests where used, a reason for dissatisfaction with any equipment or procedure, a comparison between more than one procedure or more than one type of equipment where used on a given test, and suggestions on improvements of TAPPI Standard procedures. It was also requested in this survey that the mills list some procedures, not officially recognized in the industry, which they feel should become a part of TAPPI Standards so that the information can be passed on to the proper TAPPI committee.

Replies to Questions 1–7

Tons production/day	Number employed	Man-hours/100 tons Control	Man-hours/100 tons Record	Man-hours/100 tons Total	24-Hour control	Humidity room
Fine Paper and Specialty Mills						
Over 200	51	150	25	175	Yes	50%
Under 25	4	120	0	120	Yes	50%
50–100	5	40	17	57	Yes	50%
50–100	5	30	8	38	Yes	50%
Over 200	12	11	21	32	Yes	50%
50–100	3	28	2	30	Yes	50%
Over 200	22	28	2	30	Yes	None
100–200	3	16	2	18	Yes	None
100–200	3	17	0	17	Yes	None
100–200	5	6	10	16	No	50%
Coarse Paper, Board, and Straw Mills						
50–100	4	28	8	36	Yes	50%
100–200	8	12	20	32	Yes	None
Over 200	24	25	5	30	Yes	50%
50–100	3	0	6	6	Yes	40%
50–100	1	2	1	3	Yes	None
100–200	1	2	1	3	No	None
50–100	1	0–32[a]	0	0–32[a]	No	None
50–100	0	0	0	0	No	None
50–100	0	0	0	0	No	None

[a] Report that testing depends upon product—usually 0 but on certain grades 32 hours.

	Question 8—Frequency			Question 9—Make of Equipment	Question 10—Procedure			Question 11—Satisfied?	
	R	O	N		TS	MTS	Other	Yes	No
Weight	19	..	..	See comments	10	7	1	18	..
Moisture	13	4	2	See comments	3	7	8	13	3
Bulk	4	4	4	See comments	4	2	2	8	..
Caliper	16	2	1	See comments	12	4	3	16	1
Ash	6	5	5	Muffle furnace	6	5	..	10	..
Filler analysis	1	6	8	.....	4	..	2	6	1
Air permeability	8	4	4	Gurley	6	4	1	13	..
Bursting strength	15	4	..	Perkins	11	7	1	14	3
Puncture	1	..	13	G.E.	..	..	1	..	..
Folding endurance	3	5	6	Schopper and M.I.T.	7	1	..	5	3
Tearing resistance	10	6	3	Elmendorf	11	4	1	15	..
Tensile	4	7	4	See comments	8	4	1	10	1
Stretch	1	6	8	See comments	1	2	1	6	1
Expansion	..	3	12	.....	..	1	2	2	..
Stiffness	6	4	8	See comments	3	2	5	8	..
Softness	1	2	10	See comments	1	..	3	2	1
Smoothness	2	7	6	See comments	5	2	2	2	6
Gloss	5	2	9	See comments	3	2	1	..	6
Erasure	1	4	11	.....	..	1	4	2	1
Pick	9	3	4	Dennison wax	4	2	1	7	4
Scuff	..	3	12	See comments	..	..	2	2	1
Blocking resistance	..	3	12	.....	..	..	3	1	1
Bending	5	3	8	See comments	1	2	3	4	2
Scoring	1	5	9	See comments	..	..	2	3	2
Brightness	11	2	4	See comments	9	1	3	10	2
Opacity	8	2	7	See comments	6	2	1	9	..
Color	10	2	3	Visual	..	..	7	7	3
Pinholes	4	5	8	.....	..	..	5	5	1
Dirt	7	5	5	.....	2	..	8	4	3
Degree of sizing	6	1	2	See comments	..	..	1	1	1
Ink absorption	5	..	5	.....	1	1	2	3	..
Water absorption	4	4	4	.....	2	2	4	5	1
Red dye sizing	1	1	7	.....	..	1	..	..	1
Pen and ink feathering	3	..	..	.....	1	..	1	2	..
Currier size	1	..	..	.....	..	..	1	1	..
Water drop	1	..	..	.....	1	..	..	..	1
Penescope	1	1	..	.....	..	..	2	1	..
K & N ink	1	..	..	.....	..	..	1	1	..
Immersion	..	1	..	.....	..	..	1	1	..
Dry indicator	..	2	..	.....	2	..	..	1	1
Acetic acid test	..	1	..	.....	..	..	..	1	..
Water permeability	1	2	11	.....	1	1	..	1	..
Fading	1	8	6	Atlas	..	..	4	4	1
Accelerated aging	..	4	10	.....	..	1	1	1	1
Total acidity	..	5	8	.....	3	2	..	4	..
pH	6	8	2	See comments	7	5	1	12	1
Rosin content	..	4	10	.....	3	1	..	4	..
Wax content	1	3	10	.....	1	1	1	3	..
Coating pickup	1	4	9	.....	..	..	3	2	1
Printability	4	2	9	{1—K & N ink 2—Vanderlip press}	..	1	2	3	..
Finish	11	2	4	.....	..	..	9	6	2
Formation	11	1	3	.....	..	..	7	6	2

	Question 8—Frequency			Question 9—Make of Equipment	Question 10—Procedure			Question 11—Satisfied?	
	R	O	N		TS	MTS	Other	Yes	No
Curl	5	4	7	See comments	1	1	6	6	2
Oil penetration	4	6	5	.....	1	1	4	6	2
Oil absorption	1	5	8	See comments	..	1	3	3	1
Kerosene saturation	..	1	13	.....	..	1	..	1	..
Shrinkage	1	1	12	.....	..	1	1	..	1
Ruling	1	1	12	.....	..	..	2	1	..
Iron	1	5	8	.....	2	1	2	4	..
Fiber analysis	..	10	5	.....	2	5	1	5	3
Additional tests made									
Grease resistance	1	1	..	.....	1	1	..	..	..
Dielectric strength	1	..	..	.....	..	..	1	1	..
Coefficient of friction	1	..	..	Special	..	..	1	1	..
Varnish absorption	1	..	..	.....	..	..	..	1	..
Oil content	..	1	..	.....	..	..	1	..	..
Splitting	..	1	..	.....	..	..	..	..	1
Water resistance	..	1	..	.....	..	..	..	..	1
Klemm	..	1	..	.....	..	..	1	1	..
Edge tear	..	1	..	.....	1	..	..	1	..
Alkali stain Resistance	..	1	..	.....	1	..	..	1	..
Flammability	..	1	..	.....	1	..	..	..	1
Sulphates and chlorides	..	1	..	.....	1	..	..	1	..

Comments on Question 12

General

A number of mills which do not have a humidity room have marked certain tests as made by modified TAPPI Standard procedures because the TAPPI Standard procedure calls for conditioning. In connection with weight, tear, and mullen, one mill reports: "The TAPPI procedure is modified inasmuch as random samples are taken in course of run, four tests are run on each sample, the average and range are computed, and the results are used statistically in Quality Control Program. This system has been found to work very well in showing the behavior in run of paper as it is being run. Also, seems very useful in checking quality maintenance from run to run."

Weight

Nine mills use the Toledo scale, three the Thwing-Albert, three Testing Machines basis weight scale, and one each used the Cody and Exact Weight. Three do not report the make of scale used. Modification of TAPPI Standard includes tearing instead of cutting samples and reporting on different basis than TAPPI Standards.

Moisture

Five use Hart meters, two use Cambridge Sword, one uses Moisture Register, and one each uses Williams tester, Fisher drying oven, Emerson drier, and two use homemade equipment. The others use ordinary scales and ovens.

Comments received from five mills are as follows:

1. The Hart Moisture Meter is used here in hopes of getting routine control values quickly, and with sufficient accuracy to satisfy a statistical Quality Control Program's use in this test wherever necessary. The gravimetric system, although accurate, seems to be too long, tedious, and subject to a great many errors when used by operators having a great number of other tests to run. Have no rigorous proof of the accuracy of this method, but we are working on it at present.
2. We have tried and do use, to a limited extent, a Hart Moisture Meter, Cambridge Sword-type hygrometer, and other types of moisture-sensitive elements. These have been satisfactory in specific uses.
3. In oven moisture determinations, we use air drawn from the relative humidity room so that the absolute humidity in the oven is constant. This gives more reproducible results. The moisture procedure is marked unsatisfactory because a better, rapid procedure is needed. An electric method which gives consistently reliable and reproducible results is desired.
4. Tear 4 to 6-in. strip across roll as it comes off paper machine, containing 8 to 12 layers of paper. Take immediately (rolled up) to inspector's office. Discard outer 2 layers on each side, and at the same time roll up and weigh on basis weight scale. Place in oven at 105°C. and weigh again on scales. Also use Moisture Register tester.
5. Take strip off reel the full width of machine; put in a weighed can with lid; weigh on a triple beam balance; take strip out of can to dry in oven; weigh dried strip in oven on a triple beam balance with the pan extending into oven.

Bulk

Three use Perkin's Instrument, one Testing Machines, one Russell, one comments as follows: "Use bulking rule or figure from the caliper of four sheets as used by eastern book publishers."

Caliper

Seven use Cady, five use Testing Machines Schopper, one Randall & Stickney, one Otis, and one Croton Controller. One comments as follows: "We try to check caliper within an eighth of a thousandth but have never found a caliper that is accurate even find a variation in two calipers of the same make direct from the supplier. Need a really accurate caliper badly."

Ash

Modifications in ash tests include reporting ash on actual weight of paper instead of moisture-free weight and dumping ash sample on watch glass for weighing.

Filler Analysis

Two mills comment as follows:

1. Ash is multiplied by filler factor to obtain filler content of paper. Filler factors are determined by chemical analysis.
2. A microscope is used for making filler analysis.

Bursting Strength

Two mills marked this test unsatisfactory because of poor accuracy of the instrument and difficulty in calibrating.

Folding Endurance

Comments received from four mills indicate dissatisfaction with Schopper instrument and complain on the reproducibility of the tests and the excessive number of tests needed for accuracy. Two mills report that they are attempting to correlate M.I.T. and Schopper, but no good correlation found as yet.

Tensile and Stretch

Six use Schopper testers, two Amthor, three Thwing-Albert, and one Scott. General comment was that many instruments do not meet TAPPI Standard conditions and that rate of loading is in too narrow a range on the Thwing-Albert instrument.

Stiffness

Three use Gurley, four Taber, one Riehle, one homemade.

Softness

One mill uses a Gurley SPS Tester and one measures by "feel." One mill uses a homemade instrument and comments: "We do not have a method which measures the actual quality generally accredited as 'softeness,' i.e., a combination of crushability and smoothness of surface."

Smoothness

Six use Bekk, one Williams, and one Gurley. One mill comments that the Bekk instrument is no longer on the market, that it operates satisfactorily but tests too small an area and requires too much time for controlled tests. One mill reports: "The Bekk instrument does not correlate well with printing smoothness especially with sheets treated for gloss inks." Still another mill feels none of the testers measure the characteristics needed in printing, which is a combination of smoothness and softness.

George H. Pringle, Mead Corp., Vice-President, National TAPPI; Harold Joiner, Champion Paper & Fibre Co., March Program Chairman, Ohio TAPPI; Luther Engle, Richardson-Taylor-Globe, Sec.-Treas. of Cincinnati Club of Printing House Craftsmen; William Martin, Moraine Paper Co., Corresponding Secretary Ohio TAPPI

Gloss

Five mills use the Ingersoll Glarimeter. One states that the results of different operators do not check and that quite often the discrepancy is very wide. The B & L gloss meter user comments as follows: "With high gloss papers, the B & L frequently gives readings contrary to eye evaluation. This is probably due to the angle used in viewing, i.e., the eye examination is usually at a higher angle. Meager experimental work with gloss meter employing a higher angle substantiates the above."

Erasure

Two mills use homemade equipment, one counting the number of strokes required to erase typed letters and the other the number of strokes required to erase through the paper.

Pick

Four mills commented on this test. One felt that the Dennison waxes were very satisfactory and the other three felt that they did not agree with the results obtained on a press.

Scuff

One mill uses a homemade tester but objects to the fact that "homemade" instruments are not standard and handtests are indefinite.

Blocking Resistance

One mill comments: "A better procedure is needed."

Bending and Scoring

One mill comments: "We use a small commercial scoring and folding machine. The results have been satisfactory, but a considerable investment is necessary." A second mill reports that the bending test "does not distingiush borderline cases." They use the Howard Smith Board Creaser for scoring and report that they are still doing some research on the instrument.

Brightness

Eleven mills use the G.E. and three others use both the Photovolt and G.E. One mill comments: "In the range of colors and brightnesses we make we have found that the Photovolt gives brightness figures which are identical with those obtained on the G.E. instrument."

Opacity

One mill measures transparency with the Institute of Paper Chemistry instrument and seven use the Bausch & Lomb instrument Opacimeter). One mill comments that in the Bausch & Lomb instrument, the lamp and mirror adjustment is very poor.

Color

All mills match color visually. One comments: "The personal factor is great even with constant uniform light source."

Dirt

One mill comments: "The method is affected too much by the human element in judging particle size and area. The value is relative only and this only for the same operator." Some mills use visual inspection only without attempting to make counts.

Degree of Sizing

Two mills use penoscope, one uses Valley size tester, one a Cobb size tester, and two use homemade equipment. Two mills use the dry indicator method, one uses a special acid ink, and one uses T 432. The mill using the acid ink mixes 10 ml. of glacial acetic acid with 100 ml. of Waterman's fountain pen ink and reports, "Results correlate all exceptionally well with the amount of size used in the beater." One mill considers the dry indicator method far superior to the ink flotation test and states, "The furnish effects the results on the Currier size tester and the ink flotation tests." One mill reports the procedure for soaking the sample in water until the tensile strength reduces to a certain point. The time required to reduce to this point is a measure of the degree of sizing. A mill using the water drop test reports that the test measures too small an area and does not correlate well with troubles encountered in gluing.

pH

Four use Beckman, four use Hellige Comparator, one a LaMont, one a Taylor color comparator, and one an L & N electrometric.

Finish

One mill comments: "Dissatisfied with finish tests since results are dependent upon judgment of individual testers. Should have instrument by which finish is measured electronically."

Formation

Two mills expressed need for better methods of measuring formation as visual comparison is too dependent upon individual operators.

Curl

One mill uses Taber and one a Gurley stiffness tester for measuring curl. Two other procedures given are as follows: (1) In the curl test we use, the sheet is dried at 110°F., and the amount of curl is measured. We have found that it is not altogether dependable in indicating how a sheet will act when it is processed further. We would like a test (or tests) which would give a more comprehensive picture of what we might expect of a sheet under service conditions. (2) We measure difference in height of a 1-inch stack of paper cut $8^1/_2$ by 11 (grain the long way) at the four corners vs. center of stack. (Note if curl is toward wire side of paper.)

Oil Absorption

One mill measures the loss of gloss and states, "This gives a fairly good indication of the rate and amount of oil absorption but is still not fine enough to pick up anything but rather large differences. When I speak of amount I mean that we can, in general, predict ink mileage. A more sensitive test is desired."

Fiber Analysis

Four mills reported on fiber analysis. One uses Wilson's stain exclusively; two use "C" stain, Herzberg's and Selliger's, and the fourth uses Herzberg's, Selliger's, and Lofton-Merritt stains.

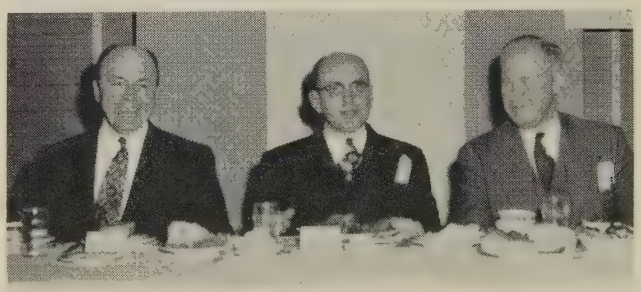
Greaseproofness

One mill comments as follows: "The TAPPI method is once again modified to yield quick statistical information. Samples are taken periodically and four greaseproof tests are run per sample. Average and range of samples are computed and used on quality control charts. There is a great deal of variance in the turpentine test, but by using statistical techniques it can be shown that the greatest variance in the whole procedure is in the paper itself; specks, shives, pinholes, thin spots, etc., causing the greatest difficulty. Using the quality control system enables one to set reasonable turpentine specks, and will point out significant differences fairly well during course of paper run. The amount of testing done by TAPPI method is far too great, per sample, for ordinary control testing, and thus the statistical approach had to be used."

Tests Needed

The following comments were listed under the classification of Tests Needed:

1. Extension and clarification of tests used to evaluate wet strength papers, for example, wet opacity.



R. D. McCarron, Stein-Hall Co., Inc., Treasurer Ohio TAPPI; John L. Clouse, Oxford-Miami Paper Co., chairman Program Committee Ohio TAPPI; R. G. Macdonald Sec.-Treas. National TAPPI

2. Fast and accurate moisture test for a strip of paper the full width of the reel; have found the Hart Moisture Meter no good at all.
3. Need a good size tester with an easily determined end point and one that is not affected by the finish of the paper.
4. Need a clarification of the tensile strength of paper and a statement as to which instrument will meet the procedure specifications.

Meeting of March 13, 1952

The Ohio Section met at the Hotel Manchester, Middletown, Ohio on Thursday, March 13, 1952. This was a combined meeting of Ohio Section and the Cincinnati Club of Printing House Craftsmen. This affair was started last year when the section was the guest of the Craftsmen at Hotel Alms in Cincinnati. This year we were the hosts.

Ohio TAPPI was highly honored by having the "top brass" of National TAPPI present; namely, Geohegan, Pringle, and Macdonald. Due to the nature of the program, the executives of the paper mills in this region were extended a special invitation to attend, and many were present.

Distinguished guests at the head table were introduced by Chairman Smith as follows: R. D. McCarron, Treasurer; John L. Clouse, Program Chairman; R. G. Macdonald, National TAPPI Secretary-Treasurer; H. T. Randall, Vice-President of the Champion Paper & Fibre Co.; our speaker, D. C. Everest, President Marathon Corp.; Carl Magnus, Superintendent of Moraine Paper Co.; K. P. Geohegan, President National TAPPI; A. Ellmore Price, Vice-President and Program Chairman of Cincinnati Club of Printing House Craftsmen; George H. Pringle, Vice-President, National TAPPI; Harold Joiner, March Program Chairman; Luther Engle, Secretary-Treasurer of Cincinnati Craftsmen; and William C. Martin, Corresponding Secretary. Brief remarks were made by Price, Pringle, Geohegan, and Macdonald.

During the short business meeting, Chairman Smith appointed the following nominating committee: Art Thurn, Chairman, Don Goodman, Phil Cade, H. P. Petzold, and George Pringle, who are to report a slate of candidates for our annual election on May 8.

The meeting was turned over to Harold Joiner, March Program Chairman, who introduced H. T. Randall, Vice-President of Champion Paper & Fibre Co. Mr. Randall then introduced our distinguished speaker, D. C. Everest, President of Marathon Corp.

Mr. Everest's talk was titled, "Research Is Disturbing." He began by relating interesting happenings in his early days in the paper industry, and told of the trouble experienced then with our National Governmental waste.

The speaker stressed the great need for technically trained men and women in industry and told of alarming increases in the number who will be employed by Government projects, leaving all too few for private industry, (ours included).

Mr. Everest predicted that paper and paperboard consumption in the United States will exceed 32,000,000 tons in 1952. The present per capita consumption is now 415 pounds.

The development during the next five years of semichemical pulps will have a tremendous effect on our industry,

H. T. Randall, Vice-President Champion Paper & Fibre Co.; D. C. Everest, President Marathon Corp. (speaker); H. A. Smith, Mead Corp., Chairman Ohio TAPPI

Carl Magnus, Moraine Paper Co.; K. P. Geohegan, Howard Paper Mills, Inc., President, National TAPPI; A. Ellmore Price, Ander Chemical Co., Vice-President & Program Chairman, Cincinnati Club of Printing House Craftsmen

similar to that of the introduction of sulphite pulp around 1870. New pulping methods, bleaching, etc., will be developed for semichemical pulp, which will find uses in all grades: bleached, unbleached, and mechanical. The use of heretofore relative unused wood species will come about. Much work and research will be needed to adapt this pulp to use in our various paper grades.

Carl Magnus, Superintendent of Moraine Paper Co., and a long-time friend of our speaker, thanked Mr. Everest on behalf of Ohio TAPPI for honoring us with his presence and giving us such a timely message. Adjournment was at 9:20 p.m. Attendance was 222.

Note: Mr. Everest's address is printed in full in the April issue of *Tappi*.

H. A. Smith, *Chairman*
Ohio Section

New England

The New England Section held its March meeting at the Cloverhill Restaurant, Fitchburg, Mass., March 21, 1952. During the afternoon visits were made to the mills of Louis DeJonge Co., Fitchburg, Mass., Mead Corp., Wheelwright Div., Leominster, Mass., and Fitchburg Paper Co., Fitchburg, Mass.

An Executive Committee meeting was held at 4:00 p.m. at the home of George Wallace, Sr., President of Fitchburg Paper Co. H. W. Knudson, Chairman of New England Section, presided.

At 5:00 p.m. the following companies were hosts to the TAPPI group at a cocktail party held at the Cloverhill Restaurant: Fitchburg Screen Plate Co., Morey Paper Mill Supply Co., Union Machine Co., Union Screen Plate Co., Hope Rubber Co., Simonds Saw & Steel Co., Magnus Metal Div. of National Lead Co., and Rollstone Foundry Co. all of Fitchburg, Mass., and Improved Paper Machinery Corp. of Nashua, N. H.

Two hundred members were at the banquet which was followed by a discussion of "Deinking." Randall Doughty, Chairman of Arrangements, presented the following panel members; Alfred H. Nadelman, Western Michigan College, Moderator; A. M. Altieri, Tileston & Hollingsworth Co.; Philip S. Bolton, Robert Gair Co.; Francis R. DiFranco, National Adhesives Corp.; Fred C. Goodwill, St. Regis Paper Co., Kalamazoo, Mich.; Robert Graham, Graham Paper Stock Co.; Joseph F. Baigas, Jr., New England Resident Engr.; National Council for Stream Improvement.

R. G. Macdonald, Secretary-Treasurer of National TAPPI, voiced greetings from National TAPPI President K. P. Geohegan and the other national officers. Mr. Macdonald said that deinking is a subject of great importance to the paper industry and that TAPPI is working on a monograph covering information on the troublesome phases of this pulping operation.

Randall Doughty, Chairman of Arrangements, then turned the meeting over to the following panel members after stating

that "the deinking problem is one of getting usable pulp and getting rid of junk in getting that pulp."

Mr. Baigus reported briefly on some of the problems at the deinking waste demonstration treatment plant at Plainwell, Mich. He said that the best method thus far used in handling the solids which enter the stream from the mill effluent is a sedimentation system which reduces these solids greatly, the balance of the sludge being dried and disposed of on land. He spoke also of aeration of the waste effluent as a second phase.

Dr. Nadelman told of research at Western Michigan College on utilization of this sludge from deinking mills and material has been recovered for reuse in the deinking mills and in the building industry in conjunction with concrete mixtures.

Mr. Goodwill commented on "What Is Desirable in Raw Material for Deinking?" with a reference to the confusion of the waste paper dealer. He explained that what one mill rejected another mill accepted gladly, but with the easing off of demand the paper manufacturer and paper user are becoming more choosey. Mr. Goodwill said that all mills now using waste paper must continue using it because if they do not there will not be an adequate pulp supply. He said that waste dealers cannot be expected to sort out all objectionable matter and he displayed samples of plastic-coated and enamel-coated paper as an example. The mills, he said, must help the waste material dealer by identifying the objectionable matter and by determining possible uses for these rejects. He said the rejects must be traced back to their source.

James J. Forsythe, Jr., International Paper Co., Niagara Falls, N. Y., and Chairman of the TAPPI Deinking Committee, reported on his committee's plans and work that has been done since its inception a year ago. He said the members of the committee represent every section of the paper industry and a preliminary study and chart have been made on magazines containing objectionable adhesives in binding and coating. Mr. Forsythe said the committee would like to expand its work to all interested and added that TAPPI is now sending out a questionnaire for use in the preparation of a monograph. He said there are many problems involved, but by an exchange of views good progress will be made in arriving at solutions.

A. M. Altieri was asked "What Are These Troublesome Materials and How Can One Detect Them?" Mr. Altieri listed them: (1) press wiping papers; (2) plastic bindings; (3) colored lacquer and varnish coated papers; (4) metallic ink papers; (5) inks based on Gilsonite; (6) delayed action hot melt labels; (7) flying pasters.

Mr. Altieri said that the trouble may be solved to a large extent through the cooperation of the printers and others who sell to the waste material dealers. He urged that the information gathered in the mills should be passed to the TAPPI Deinking Committee for study and action.

Mr. Bolton touched lightly on the broad troubles that the board mills have with waste paper, this type of mill using about 90% of all the waste paper consumed in the paper industry. He said that asphalted papers presented the biggest problem, but with rubber, wood, scale, crystals, glass, metal, cellophane, and wet-strength papers contributing to the troubles.

Mr. Bolton, reporting on some lengthy investigation by the Research Department of the Robert Gair Co., said that screen plates with $^1/_8$ and $^1/_4$-inch holes removed objectionable particles from the stock far more efficiently than slotted screen plates. He said it is wise not to forget that a lot of dirt accumulates in white water.

F. R. DiFranco told of how work by the National Adhesives Corp. on adhesives for the printing field switched from starches and animal glues when a demand for better products resulted in the adhesive manufacturers making such items as the heat-seal labels which are troublesome to papermakers. Mr. DiFranco stated that the adhesive manufacturers are working to ease these problems for the papermakers and invited the latter to send in objectionable matter for study. He said that the adhesive manufacturers are ready to cooperate.

Robert Graham presented the view of a waste paper dealer and stated that the waste industry generally is ready to cooperate. Mr. Graham said that the scrap dealer is in an awkward business in which there is no standard of quality and the business is highly competitive. He said that it is only in recent years that the waste paper dealer has been reasonably recognized by the scrap producer and the mill.

Mr. Graham advised that each mill select a waste paper dealer and work with him to do a good job for the mill in processing material that will better suit the purposes of the mill. He urged that the mill then pay the dealer a fair price for his work and for the extra processing necessary to eliminate the objectionable matter.

PAUL D. APPLEGATE, *Secretary*
New England Section
J. J. O'BRIEN
Paper Mill News

Lake Erie

The February 15 meeting of the Lake Erie Section was called to order at 8:15 p.m. by Chairman Bill Hasselo of the Container Corp. of America, who welcomed the 40 members present.

Mr. Hasselo announced that plans for the combined Folding Paper Box Association-Lake Erie TAPPI Folding Carton Conference are rapidly shaping up, the principal speakers had been engaged, and that a good turnout was expected by the committee. It was announced that the meeting was to be held at the Hotel Carter in Cleveland on May 23 and would be an all-day session followed by dinner and a speaker.

It was also announced that the March 15 meeting would be on the subject of "Graphic Arts" and that an appropriate speaker was being lined up.

Mr. Hasselo then introduced Mel Goffinet of the Ohio Boxboard Co., who presented a paper entitled "How Our Suggestion Plan Works."

Mr. Goffinet's remarks follow:

How Our Suggestion Plan Works

First, I should like to thank you Mr. Chairman and TAPPI for this opportunity to come before you tonight and tell you about our suggestion plan at the Ohio Boxboard Co.

It all started back in 1948 when management felt that a good sound suggestion plan would have healthly effects on our company, etc.

I. Objectives for installing plan.
   1. Reduce manufacturing costs.
   2. Improve employee relations.

Joseph Harwood, Morton Suggestion Systems; William Hasselo, Container Corp. of America; and Mel Goffinet, Ohio Boxboard Co.

3. Improve product quality.
4. Increase machine limitations.
5. Improve material handling.
6. Reduce waste.
7. Many others—safety, clerical routine—stir imagination of work force, quicken their thinking process.

II. Limitations of plan.
1. Plan must have rules.
   a. Ineligible suggestions: no definite proposal; proposal is routine function of maintenance; existing standards cover proposal; proposal is duplicate; suggestions on equipment, etc., in development stage; savings will not justify expenditure; suggestion concerning complaint or grievance; suggestion on emergency technique.
   b. Ineligible persons.
      (1) Executives—department heads—foremen.
      (2) Individuals in research—development—plant engineering—methods improvement—industrial engineering, assigned projects to hourly workers.
      (4) Awards can be approved to such of the above if not related to duties, assignments, etc.
      (5) Persons assigned specific duties.

III. Plan.
Brief A. Receipt—investigation—committee action.
1. Receipt—personnel department.
   a. Fills out blank.
   b. Old and new idea.
   c. Sketch.
   d. Drops in box.
   e. Collected and recorded by personnel.
   f. Receipt given to employee.
2. Investigation—industrial engineering—personal contact.
   a. Records suggestions.
   b. Contacts suggester—foremen—department head.
   c. Sees that work order is entered.
   d. Follows up work order.
   e. Calculates savings—tangible suggestions.
   f. Check on cost of adoption.
   g. Compute award.
3. Committee action.
   a. Committee appointed by management chief engineer, construction engineer, and assistant to the treasurer.
   b. Investigator reviews old and new idea with committee after adoption.
   c. Questions investigator in detail if necessary.
   d. Committee discusses suggestion—investigation and final adoption or rejection.
   e. Recommends final action for consideration.
   f. Decides on award—deferment—reinvestigation, etc.
   g. Employee must be on payroll at time of final action by committee.
   h. Letters to suggester on—rejection and why—award adopted—award—check.

IV. Classification and computation of award.
1. Classification—need for:
   a. Maintain records.
   b. Justify limitations of suggestion to employee.
2. Suggestion accepted.
   1-a. Tangible savings—maximum $1050 (3 paid).
   1-b. Intangible savings—$5–$25.
   1-c. Safety—housekeeping.
   2-a. Deferred.
   2-b. Not acceptable—rejected.
3. Calculating of award.
   a. A suggestion involving tangible savings and an expenditure of over $500 will not be paid in full until accurate savings can be determined (1 year).
   b. Explanation of how we calculate a tangible award 35% (savings—1/3 investment)—award.
   c. 1/3—investment over 3 years.

V. Success of our system 1948–51. Charts.
1. Suggestions received per thousand employees.
2. Per cent adopted.
3. Average award.
4. Total savings.

VI. N.A.S.S.
1. Function of organization.
   a. Founded in 1942.
      1. Has a membership representing millions of employees.
   b. Compare suggestion, programs, procedures technique.
   c. Assist employees and management to cooperate and be mutually successful.
2. Comparison O.B.B. with N.A.S.S. latest reports.

	O.B.B.	*N.A.S.S.*
a. Receipts per thousand employees per year	1:2.35	1:2 av.
b. Adoptions	29%	25%
c. Average award	$29	$20

VII. Plans for future—improve quality of our suggestions.
1. Intensive methods training program.
   a. Technique in methods simplification.
   b. Foremen's training program.
   c. Employee booklet explaining technique—flow chart.
2. Methods simplification tied in with suggestion program.
   a. Expect to adopt 50% of all suggestions received.
   b. Anticipated participation in program, 50 suggestions per thousand employees.

In closing, I have in a brief way explained how our plan had its beginning, how we investigate and take final action on our suggestions, how we compare with other industry, and what our plans are for the future. It has been a pleasure being here tonight—thanks again for the invitation.

Mr. Goffinet's talk was followed by some informal remarks by Joe Harwood of the Morton Suggestion Systems. Mr. Harwood outlined some of his experiences with suggestion Systems. Mr. Harwood outlined some of his experiences with suggestion systems. Mr. Harwood also discussed some of the problems which have been encountered in installing and administering suggestion systems, such as ways and means by which the systems could be controlled and methods of determining awards. Mr. Harwood was in favor of suggestion systems for supervisors at the foreman level, with the danger of the foreman stealing the workers' suggestions for his own use eliminated with a suitable method of controlled presentation of any suggestion. Several means were discussed, such as tear-off suggestion forms where the suggester remains anonymous except by code number. Mr. Harwood outlined the economics of the suggestion plan and said that in all cases the pay-off to the company exceeded many times pay-out to the suggester.

After a lengthy discussion period where many present exhibited interest in the speakers' remarks, the meeting was adjourned at 10:00 p.m.

R. L. Lewis, *Publicity Chairman*
Lake Erie Section

Meeting of March 15, 1952

The Lake Erie Section met at 8:15 p.m. on March 15 at the Hickory Grill in Cleveland, Ohio. William Hasselo, Container Corp. of America, presided. He received the report of the Nominating Committee for officers for the coming year. Plans were announced for the Folding Carton Forum to be held on May 23 in cooperation with the Technical Committee of the Folding Paper Box Association of America. This will be an all-day meeting. Plant visits will be arranged for Thursday afternoon. Six nationally known speakers have been scheduled to give papers on various aspects of folding cartons.

Program Chairman, Joseph H. Thompson, Minerva Wax Paper Co., introduced the speaker, Douglas E. Tuttle, International Printing Ink Div., of Interchemical Corp., who talked on the "Aniline Printing Process." Mr. Tuttle gave a résumé of the history of the process and how it has developed since it was introduced in 1890. The process was described as a rotary typographic printing process using a press with a two-roller distribution system, flexible rubber plates, and fluid, quick-drying inks. Various modifications of the press were described and the ink distribution systems explained. The advantages, disadvantages, and latest developments in rubber plates were pointed out. Mr. Tuttle discussed the modern aniline inks and what they would do. Most inks have to be formulated for the type of printing as well as the material to be printed. Samples of various types of printing on paper and some of the transparent films were shown. The aniline process should continue to develop as it has in the last 50 years.

Although tone plates are generally limited to an 85-line screen, finer screens have occasionally been printed with creditable results. Sheet-fed work has not been developed today as much as it is likely to be in the future. There is no mechanical reason why this can't be done. A few machines have been converted to do this type of work and have proved their value to their owners. Aniline printing is a "natural" for printing corrugated containers and other bulky materials, where the present conventional inks create a real problem in the space required for storing large quantities of printed stock during the usual 4 or 5-hour drying cycle. Aniline printed stock would, of course, require no "drying time" storage at all and could be overprinted, taped, or shipped immediately. It was pointed out that the aniline process has had its greatest growth during the competitive situation created by the depression of the 1930's. It would be expected that, during any future period of strong competition, the aniline process will make greater gains in the printing industry.

Some of the points brought out during the discussion period are as follows: generally, the number of impressions obtained from a rubber plate varies between one and three million depending on the job. As many as sixteen million have been obtained.

In printing with aniline inks, one depends on both trapping and drying. The inks are partially dried and the solvents are varied with the inks used on the different stations.

Twenty-five per cent of the aniline inks are made with dyestuffs and the remainder use pigment colors.

The training time for operators to become expert with the process is somewhat shorter than for other printing processes.

It is not advised to make ready on the press. Using a make-ready jig and with care in mounting after some experience, it can be mounted satisfactorily the first time.

There is no pat answer for the elimination of ghosting. It is caused by a heavier ink film which was not completely removed on the previous revolution of the plates. Some things that help are covering the fountains, using distribution rolls that supply a more uniform ink film whether or not all the ink had been removed by the previous impression, and mounting a soft rubber ride roller on the form roller.

Pinholes in the ink when printing on a material like cellophane can be mechanical or chemical. With the mechanical, it is due to a light impression resulting in no contact. With the chemical, certain spots are not wetted by the ink and the ink crawls away.

Lint is not a problem because the fluid wets the lint and prints it off or else it works back and collects in the fountain.

Special inks can be formulated to withstand high temperatures up to 400°F. The average ink softens at 175 to 240°F. Inks can also be made to heat seal.

Steel impression cylinders remain more accurate while rubber cylinders, although more easily damaged, are used for special conditions, such as to help register control and on light tissue where the ink goes through the stock.

L. E. Rolig, *Secretary*
Lake Erie Section

Southeastern Pulp and Paper Society

A meeting of the Southeastern Pulp and Paper Society was held at the DeSoto Hotel, Savannah, Ga., on Friday evening, March 21. There were 110 in attendance at this meeting, which was centered about the subject of pulp mill by-products. Chairman of the Society, Glenn Kimble, presided.

Mr. Kimble introduced Claude Adams, Assistant Manager of the Southern Paperboard Corp. of Port Wentworth, Ga. Mr. Adams spoke a word of welcome and expressed his pleasure with the large attendance at the meeting. He extended an invitation to visit his plant Saturday morning, indicating that guides would be available for this purpose. Following the technical program, Mr. Adams was again introduced, and gave a brief description of the plant and its equipment.

This year's TAPPI medal winner, R. S. Hatch, was introduced. Mr. Hatch is a former President of TAPPI, and is now Research Director for Hudson Pulp and Paper Co. at Palatka, Fla.

The new officers of the organization are scheduled to take up their duties in September. The Nominating Committee which is considering candidates was introduced by Glenn Kimble. It is composed of J. R. Lientz, Chairman, K. M. Guest, C. L. Clark, R. C. Richter, and G. E. Scofield.

Mr. Kimble announced that the Executive Committee intends to go forward with plans to apply for a TAPPI Section charter.

In the report of the Secretary-Treasurer, it was pointed out that there are now 118 members, 28 of whom are sales people, and 90 are chemists, operators, teachers, or plant officials. Seventy-three members of the Society are also TAPPI members or have applied for membership.

The meeting was turned over to Malcolm Pineo, Program Chairman, who pointed out that the program for the evening was centered about the three main by-products of the industry: lignin, bark, and turpentine. Mr. Pineo then introduced Paul R. Wiley, Director of Development, West Virginia Pulp and Paper Co., who presented a talk on "The Use of Lignin in Rubber." This talk had been previously given at the TAPPI Annual Meeting, and will soon be published in *Tappi*. Mr. Wiley mentioned the properties of rubber made with lignin as an additive for reinforcing purposes, and compared its use in this manner with carbon and mineral additives used by the rubber industry.

The second paper, "Some Observations in Sulphate Turpentine Recovery," was co-authored by M. R. Dusenbury and J. E. Reese of Hercules Powder Co. and presented by Mr. Dusenberry. Some of the principles in the design of sulphate turpentine recovery systems were discussed. This paper was also presented at the Annual TAPPI Meeting, and will be published soon.

A movie entitled "Suspension Burning of Bark Refuse" was narrated by Carl E. Miller of Combustion Engineering-Superheater, Inc., and was produced by Otto de Lorenzi of this same firm. The picture presented in dramatic fashion the combustion of bark, coal, and oil within a boiler employing the suspension burning principle. This movie had been presented at the Alkaline Pulping Conference held recently at Richmond, Va.

There were 40–50 visitors to the Port Wentworth mill of the Southern Paperboard Corp. Visitors to this kraft mill, which went into production in 1948, were impressed by its modern equipment and buildings, as well as by its cleanliness.

The next meeting will be held at Charleston, S. C., on May 16, and will include a mill tour of West Virginia Pulp and Paper Corp.

Following is a discussion of the papers presented:

1. "The Use of Lignin in Rubber," by Paul R. Wiley, West Virginia Pulp & Paper Co. (Questions answered by Mr. Wiley.)
   - Q.: Ted Haywood, Combustion Engineering-Superheater, Inc. What is the comparative abrasion resistance of tires using lignin additive?
   - A.: Abrasion resistance is not quite as good as tires using carbon. There seems to be a high heat build-up in tires which lignin was used. However, there has been only one case where a tire has been compounded so that this problem could undoubtedly be solved through research.
   - Q.: Malcolm Pineo, Brunswick Pulp & Paper Corp. Can you give us a cost comparison of the use of lignin vs. carbon or mineral pigments in rubber?
   - A.: Lignin is in an excellent position from a cost standpoint. It is believed that the lignin can be produced for less

than five cents per pound, compared to 5½–10 cents for carbon black and higher for other mineral pigments.

Q.: Ted Haywood. What is the heat value of the lignin?

A.: Only 50–60% of the lignin would be recovered for use in by-products so that there is 6500 B.t.u. per pound which drops to 5000 as returned to recovery furnace. We hope that some day a recovery furnace will be a thing of the past.

Q.: A. Ryfun, Rayonier, Inc. Has the method of concentrating lignin by the use of "freezing out" principle been tried as employed by citrus industries?

A.: It has been tried with success, but is prohibitive from a cost standpoint.

Q.: J. E. Overall, Union Bag & Paper Corp. What has been done with the chemical recovered by your process?

A.: No attempt has been made to use this chemical. This would be a problem of the rubber plant.

2. "Some Observations on Sulphate Turpentine Recovery," by M. R. Dusenbury and J. E. Reese, Hercules Powder Co. (Questions answered by Mr. Dusenbury.)

Q.: Malcolm Pineo. What is the yield of turpentine up and down the coast?

A.: A survey made on the basis of plant yields indicates the following: slash and longleaf, 3½–4 gal./ton of pulp; Virginia loblolly, 2–2½ gal./ton of pulp; Jackpine (Midwest and Canada), 1½–2 gal./ton of pulp. (We have no laboratory data on this.)

3. "Suspension Burning of Bark Refuse," produced by Otto de Lorenzi and narrated by Carl E. Miller, Combustion Engineering-Superheater, Inc. (Questions answered by Mr. Miller.)

Q.: Fred Cook, Brunswick Pulp & Paper Co. How do you estimate the size of larger particles of wood?

A.: The jobs vary with sizing of wood depending on the use of hogs, etc. The less fine material, the more material burns on the grate. Roughly speaking: From ¼ to ½-inch particles move upward and downward in the turbulent air currents. Heavier than this move right down. Smaller than this move upward.

Q.: With tangential jets, do you have to increase excess air over other types of bark boilers?

A.: No, because good mixing and low fuel bed make efficient use of air. Sixteen per cent is a good figure. Beyond that, you will run into unburned hydrocarbon which does not necessarily show in your CO_2 test. One forced-draft fan supplies overfire air and under-air.

Q.: How much of the air is overfire air?

A.: Sixty per cent overfire air; 40% through grates.

Q.: Where are the jets located?

A.: There are 7 rows of jets, four jets per row, one row in each corner. Each row is reversed in direction, which accounts for the turbulence.

Q.: George Whiteside, Container Corp. of America. How much ash is returned from the ash collector?

A.: About 2%.

Q.: What about sand reinjection in the furnace?

A.: There is sand reinjected into the furnace and the question of whether it was carrying up and scouring the tubes. Inspection has shown that there was not even a polishing of the tubes. It is believed that the reason for this is that the sand settles out due to lower air velocity through the grates.

Q.: H. T. Scordos, Union Bag and Paper Corp. With turbulent effect, can comparable ratings be obtained with coal and oil by maintaining excess air at a minimum?

A.: Yes, although a slightly larger furnace is required with coal. Height at which fuel is introduced may require adjustment. We are thinking in terms of eliminating pulverizers. Instead, the use of spreaders with a turbulent effect, burning as much as possible in suspension, and the balance on the grates. It is possible also to use a combination of wood and coal.

G. E. Scofield, *Secretary*
Southeastern Pulp & Paper Society

Empire State Section (Metropolitan District)

The Metropolitan District of the Empire State Section held its annual Ladies Night on March 11 at Fraunces Tavern, New York City, with William R. Willets, Chairman, presiding. In spite of typical inclement March weather about 60 were in attendance.

As usual each member introduced himself and then his lady. Business matters were held to a minimum but the chairman appointed a nominating committee consisting of Henry Perry, Ivar Ekholm, and Robert Emerson to report on nominees for next season at the April meeting.

Frank Lovejoy of the Socony-Vacuum Oil Co., an outstanding speaker, delivered an excellent address on the importance of merchandising and the factors entering into merchandising in every field—personal, economic, social, and political as well as in business.

He described the founding and growth of the Socony-Vacuum Oil Co. in a graphic and amusing story but his illustrations were not confined to the petroleum industry and he drew on every walk of life to drive home his points. He stressed that without effective merchandising and marketing there would never be mass production and that this lay at the root of the American way.

His amusing extemporaneous talk left much food for thought. An enthusiastic rising vote of thanks was extended the speaker.

L. E. Georgevits, *Recorder*

Empire State (Northern District)

The Northern District of the Empire State Section met at the Hotel Woodruff, Watertown, N. Y., on March 13, 1952. About 70 attended.

The principal speaker was H. K. Kingsbury, Application Engineer for the Allis-Chalmers Mfg. Co., Milwaukee, Wis. His talk was entitled "Pumps for the Paper Industry."

Meeting of April 10, 1952

The Northern District of the Empire State Section met at the Hotel Woodruff, Watertown, N. Y., on April 10, 1952. The principal speaker was A. B. Recknagel, Technical Director of Forestry, St. Regis Paper Co., Deferiet, N. Y. Mr. Recknagel's talk follows:

New York's Forests and the Paper Industry

At the outset, I promise not to burden you with statistics on production, past and present, in our State and Region and in our pulp and paper industry, except to establish a proper background. The obvious fact is that, in common with the other North Atlantic States, New York's wood pulp capacity has remained static for some years whereas that in the rest of the country has been increasing rapidly. Of total United States wood pulp production, New York now has about 5%, while of total United States paper and paperboard production, it has nearly 10% and ranks first among all the States of the Union.

Similarly, the Northeastern States (New England, New York, and northern Pennsylvania) in the year 1951 consumed close to four million standard cords of pulpwood (or 17% of total in United States) of which over 70% were softwoods. In fact, as recently as January of this year, of the pulpwood consumed in the Northeastern States, that month, 80% was softwoods and of the remaining 20%, two thirds was of the "mixed hardwoods" and one third was poplar.

But enough of statistics. The indisputable fact is that our industry is *not* expanding in the State of New York and that at best it is in a precarious equilibrium. For this trend the phrase "flight from the North" has been coined with rather telling effect. So far as this trend concerns mills and manufacturing, I shall leave it to abler persons to deal with. My intention and hope is to throw a little light on the forest resources of the State as these are related to the paper industry.

From time to time statistics on New York's forest resources have been assembled. I have been guilty myself of such. Frankly, they were little better than "guesstimates" until the Northeastern Forest Experiment Station of the U. S. Forest Service issued the first of its "Forest Statistics for New York"—namely No. 1 (Delaware, Otsego, and Schoharie Counties). A similar report is contemplated for each of the other forest districts in the State of New York in order to provide basic forest statistics. When these further reports are released, we will, for the first time, have reliable data on the timber resources of the North Country, which is where the paper industry is particularly concerned.

In advance of such statistics, it is possible to point to two divergent trends. The first of these is the over-all *depletion* of the softwood component and the second is the over-all *increase* of the hardwood component. For example, in 1949–50 St. Regis Paper Co. made a detailed inventory of its Northern New York hold-

ings—some 150,000 acres—and found that of the volume present *one* quarter was softwoods and *three* quarters was hardwoods. The lands of our company are quite typical of the Northern Adirondacks. The entire area had been cut over, sometimes repeatedly. In other words, this is second growth following previous logging of the softwoods for sawtimber and for pulpwood and of the hardwoods for sawtimber only. The hardwood component is primarily beech, birch, and maple (both hard maple and soft maple) with a surprising amount of cherry also present. Nor is it equally distributed. The softwoods—chiefly spruce and balsam fir, with the latter predominating—are found on the softwood types (swamps and flats) and the hardwoods on the better drained soils of the area. Also, with respect to sizes, the softwoods, having been cut over for pulpwood, are uniformly smaller than the hardwoods which were cut only for sawlogs. What is not so well understood, generally, is that the hardwoods—particularly the birch and the maple—are making as good a growth rate as the softwoods. In terms of volume per acre the second growth of the hardwoods is particularly good, approximating a half cord per acre per annum on the best sites as against a quarter cord yearly per acre for the spruce and fir.

Since the softwood component is obviously unable continuously to supply the demand of the existing Northern New York mills, the choice for most of them is of the "Hobson" variety: either use more hardwoods or close down (with a third possibility of importing sufficient softwoods from outside the State to keep going). Fortunately, the change to more use of hardwoods is no longer so theoretical as it was. Evidence is piling up that we are—in the North—on the verge of a great expansion of hardwood pulpwood consumption. Consider, as *Time* would say, some "items":

Item 1. The Howard Smith paper mills of Cornwall, Ontario, are actively in the market for our North Country hardwoods. These are cooked to make soda pulp at what is reported to be the first mill in Canada to do so on a large scale. Elm, maple, birch, ash, and even oak are now utilized. They contemplate using a mobile chipping unit which will move from woodlot to woodlot on the North Country farms, chipping as they go and trucking the chips to the mill.

Item 2. Chief U. S. Forester Lyle Watts, in his report for 1951, mentions "successful semichemical pulping experiments... with...cherry, birch, maple, oak, ash, and beech. The tests indicate the feasibility of using woods-run pulpwood without the usual sorting of species."

Item 3. H. L. Field, in an address at the Second Annual Conservation Conference in Connecticut last November, made these very enlightening remarks: "The last ten years have seen the culmination of many years of laboratory and mill research on the subject of hardwood pulping.... Of the many new pulping techniques developed by the various research groups, there are three which are worthy of special note." He then listed:

1. The neutral sulphite semichemical pulping process.
2. The chemigroundwood pulping process.
3. The high yield kraft process applied to hardwoods.

Mr. Field described the relative advantages and disadvantages of each process and concluded that a mill using 80% of hardwoods for its fiber needs is feasible, with the remainder of its fiber needs supplied by purchased coniferous pulps or local softwood pulpwood; and "a sustained yield...by reforestation and good forest management on large acreages of marginal farm and woodlands now standing unproductive."

These viewpoints are very pertinent and all point to the same conclusion. Industry can use the hardwoods: it is up to the foresters to grow them. Now that puts it up to us and we cannot shirk the responsibility. Paraphrasing the questions asked by Dean Hardy Shirley at a meeting of the Forest Policy Committee of the American Paper and Pulp Association in New York on Feb. 19, 1952, we might ask ourselves:

(1) "Can we foresters guarantee adequate continuous supplies of raw material for the mills at reasonable cost?"

The answer to this, I believe, is *yes*. The present average volume per acre is purely fortuitous. It seldom reaches 10 cords per acre of desirable hardwoods. But judicious cutting would step it up to more than 10 cords per acre growing stock with better kinds and more thrifty individuals. The rate of growth on suitable sites can be "upped" from the present $1/4$ to $1/3$ cord per acre yearly to a general $1/2$ cord per acre yearly by giving the best trees more growing room.

As for the "reasonable cost," bark removal (chemically or mechanically), portable chipping, and mechanized logging and hauling are, or soon will be, furnishing the answers. Our best hardwood areas are generally also the most accessible.

(2) "Shall we try to utilize the changing raw material supply in this region or move to another area?"

Here the answer is *yes* to the first part and *no* to the second. Col. W. B. Greeley at a meeting in New York during "Paper Week" this year, said: "Intensive utilization is the foundation of effective management" and Chief Forester Lyle Watts supplied the correlary: "Intensive forestry can come only with intensive utilization of the products we grow in the woods."

As for moving to another area, those of you who heard Frank Heyward's address on February 19 in New York on the subject: "Can the South Sustain an Annual Pulpwood Drain of Eighteen Million Cords?" must have been impressed by the magnitude of their problems and the corresponding opportunities which we in the North have been prone to under-rate.

(3) Finally, Dean Shirley asked: "To what extent should we concern ourselves with the problem of inducing independent owners to follow forestry practices that will result in adequate timber yields to meet our needs?"

The answer to this is: It is vital that industry should so concern itself—both for softwood and hardwood production. If we are to learn from experience, we *must* offer services and a stable market to the small (and not-so-small) owners who can supply our mills. "Operation Scavenger" must give way to "Operation Sustained Production." The Southern Pulpwood Conservation Association and its related effort "The Forest Farmers Association Cooperative" have pointed the way. In the North, Brown Co. has pioneered in offering to assist owners in keeping their woodlots productive.

Before concluding my discussion of forests and forestry, the question of taxes is sure to arise. In parts of Northern New York the tax burden has become so heavy that the timberland cannot pay it without running a deficit. Our company's taxes average 24¢ an acre yearly: about double the average income per acre. We need something like New Hampshire's yield tax, otherwise the "flight from the North" will continue to its logical conclusion and the future of the pulp and paper industry in New York State will be behind it!

Personally, I refuse to believe this will come to pass. Instead, I hold to the belief that New York's paper mills will continue and will even expand. But the going will be tougher, the competition keener than heretofore. We have passed the exploitation stage and have entered that of managed forest resources. It is a challenge and an opportunity to all of us in the North Country to meet this challenge successfully.

T. Everett English, *Secretary*
Northern District, Empire State Section

Empire State (Western District)

The Western District of the Empire State Section met at the Prospect House in Niagara Falls, N. Y., on Wednesday, April 2, 1952, at 7:00 p.m. Sixty members and guests attended the meeting over which I. V. Earle, The Upson Co., presided.

The following officers and committees were elected:

Chairman—Gordon K. Storin, Niagara Alkali Co.
Vice-Chairman—James J. Forsythe, International Paper Co.
Secretary—Fred P. Heil, Lockport Felt Co.
Treasurer—E. F. Andrews, International Paper Co.
Arrangements Committee:
Chairman—R. J. Driscoll, International Paper Co.
Vice-Chairman—E. G. Miller, Carborundum Co.
Program Committee:
Chairman—Irving Earle, Upson Co.
Vice-Chairman—Paul T. Kuhnel, Kimberly Clark Corp.
Attendance Committee:
Chairman—George E. Norton, George Irish Paper Co.
Vice-Chairman—J. V. Earle, Upson, Co.
Membership Committee:
Chairman—Fred R. Sheldon, Buffalo Electro Chem. Co.
Vice-Chairman—F. B. Pickett, Kimberly Clark Corp.
Publicity Committee:
Chairman—Don M. Hart, Moore Business Forms, Inc.
Vice-Chairman—M. S. Thomson, Moore Business Forms, Inc.

Walter Mikelson, Application Engineer in the Paper and Textile Division of the General Electric Co., Schenectady, spoke on "New Electrical Tools for More and Better Paper."

Mr. Mikelson discussed various developments of the General Electric Co. designed to measure and control continuously basis weight, moisture stock consistency, tension, and flaws. Flaw detectors included magnetic detection of iron in logs and photoelectric detection of holes and other flaws in paper webs. He demonstrated the web tensiometer and discussed its varied applications for measurement and control of tension by the aid of slides. Using a Geiger counter and a radioactive source, Mr. Mikelson demonstrated the principle of the beta-ray gage for basis weight measurement.

E. F. Andrews, International Paper Co.; James J. Forsythe, International Paper Co.; Walter Mikelson, General Electric Co.· Don Hart, Moore Business Forms, Inc.; and Gordon K. Storin, Niagara Alkali Co.

He also described the moisture monitor which determines moisture content by measurement of the dielectric constant of the paper. This is a single-plate instrument that gives continuous measurements on a web. Stock consistency is determined by photoelectric measurement of the ratio of the diffused to transmitted light of the stock solution.

D. M. Hart, *Publicity Chairman*
Western District, Empire State Section

Empire State (Central District)

The Central District of the Empire State Section met at the University Club, Syracuse, N. Y., on Friday evening, March 7. It was a lively gathering, especially since 35 students of the Pulp and Paper Department of the College of Forestry attended. There were 73 present. However, the snowstorm in the Utica area made it impossible for 11 reservations to be filled.

The speaker of the evening was Durwood Geffken, Chief Chemist at the Oswego Falls Corp., in Fulton, N. Y. His subject was: "Effect of Air Temperature on the Drying Rate of Bottle Cap Board." The talk was very well presented, and interest was keen as displayed by the questions asked during the discussion period.

Meeting of April 10

The meeting was held at the University Club in Syracuse on April 4. We had 70 persons present including the senior and junior class of the Pulp and Paper Department.

The program of the evening was presented by the College of Forestry, Pulp and Paper Department. The subject was: "Bark Removal by Chemical Treatment of Trees," Edwin C. Jahn acted as the main speaker and introduced four members of the Debarking Project who each in turn told of his own particular part of the project.

Speakers at the April meeting of the Central District of the Empire State Section of TAPPI. Left to right: Felix Czabator, Hugh Wilcox, Merritt McGahan, Robert Smith, and Edwin C. Jahn

The speakers were: E. C. Jahn on history and objectives; Hugh Wilcox on over-all range ot experiments; Felix Czabator on field studies; Robert Smith on chemical distribution in wood and pulp and Merritt McGahan on effect of chemicals in cambial tissue.

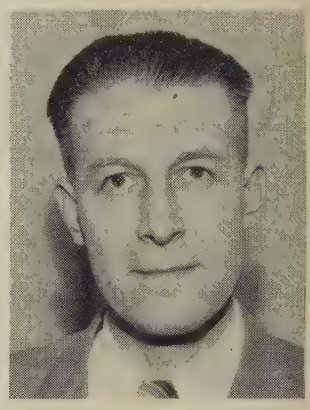
We are striving to receive better newspaper coverage. Announcements of this month's meeting were printed in newspapers in Syracuse, Fulton, Oswego, Watertown, and Utica.

Daniel V. Lent, *Secretary-Treasurer*
Central District, Empire State Section

Pacific Section (Shibley Award Meeting)

The Annual Shibley Award Meeting of the Pacific Section at Camas, Wash., March 21, 1952, was attended by some 200 members and a large delegation of students and faculty members from colleges and universities in the Pacific Northwest as guests of the Section. Mill visits to the Crown Zellerbach Corp., Camas plant, were conducted during the forenoon terminating with a luncheon at the Crown Willamette Inn.

D. B. Geffken, Oswego Falls Corp., Fulton, N. Y.



LeRoy E. Smith, Rayonier Inc., Hoquiam, Wash. Winner Shibley Award Contest, March 21, 1952

At the afternoon technical meeting in Nora Self Hall, five papers were presented in competition for the 1952 Shibley Award.

1. "A Method for the Estimation of Decay in Douglas-Fir Wood Chips," by Wesley L. Pearl, Longview Fibre Co., Longview, Wash.
2. "Sulphur Savings at Camas," by R. G. Stewart, Crown Zellerbach Corp., Camas, Wash.
3. "Sulphate Black Liquor Evaporator Tube Plugging Progress Report," by W. J. Hall, Weyerhaeuser Timber Co., Pulp Div., Springfield, Ore.
4. "Some Effects of Extreme Chip Packing in the Sulphite Process," by Alan S. Rosenfeld, Central Research Dept., Crown Zellerbach Corp., Camas, Wash.
5. "A Rapid Estimation of Calcium in Pulp," by LeRoy E. Smith, Rayonier, Inc., Hoquiam, Wash.

After lengthy deliberation, the Judging Committee awarded top honors to LeRoy E. Smith for his paper "A Rapid Estimation of Calcium in Pulp." The Pacific Section Publications Committee has decided that because of the excellent quality of the papers entered in this year's competition, all papers will be submitted to *Tappi* for publication. Past-Chairman R. I. Thieme was in charge of the 1952 contest and acted as moderator at the meeting.

At the conclusion of the technical session, the annual meeting of Pacific Section was held. The following officers were elected for the year 1952–53.

Chairman: S. E. Hazelquist, Weyerhaeuser Timber Co., Pulp Div., Longview, Wash.
Vice-Chairman: F. J. Weleber, Publishers' Paper Co., Oregon City, Ore.

Pacific Section Shibley Award Contestants, l. to r.: R. G. Stewart, Crown Zellerbach Corp.; Alan S. Rosenfeld, Crown Zellerbach Corp.; LeRoy E. Smith, Rayonier Inc.; W. J. Hall, Weyerhaeuser Timber Co.; Wesley L. Pearl, Longview Fibre Co.; and R. I. Thieme, Soundview Pulp Div., Scott Paper Co., Everett, Wash., Chairman of Shibley Award Committee and Moderator of meeting

Secretary-Treasurer: H. B. Petersen, Hercules Powder Co., Portland, Ore.
Executive Committee: B. T. Briggs, Rayonier, Inc., Shelton, Wash.; E. H. Nunn, Crown Zellerbach Corp., West Linn, Ore.; R. M. True, General Dyestuff Corp., Portland, Ore.

W. F. Holzer, E. O. Ericsson, and J. M. McEwen are members of the Executive Committee *ex-officio*.

At the dinner meeting in the Crown Willamette Inn, R. I. Thieme presented to each of the Shibley Award contestants an autographed copy of Sutermesiter's "Chemistry of Pulp and Paper." The winner, LeRoy E. Smith, was presented the monetary award.

E. O. Ericsson, retiring Chairman, presented a beautiful desk pen set to R. M. True as a tribute to his many years of service to Pacific Section as Secretary-Treasurer.

The meeting concluded with a first showing of a new Crown Zellerbach Corp. color film on "forestry."

H. B. PETERSEN, *Secretary*

Lake States

The fourth meeting of the Lake States Section was held at the Conway Hotel, Appleton, Wis., on Tuesday, March 11.

Following dinner, the meeting was called to order by Chairman A. P. Adrian. Announcements were made regarding the program for other meetings, after which Dr. Adrian introduced J. A. Van den Akker of The Institute of Paper Chemistry, who spoke on "Beta Gage Control of Basis Weight."

Dr. Van den Akker began with a historical background beginning with the discovery of radioactivity by Henri Becquerel in 1896. As long as 56 years ago uranium was used as radioactive material in work that involved the passage of beta rays through paper. Not long after, Rutherford discovered and named the alpha and beta rays and Villard discovered gamma rays. Alpha particles are helium nuclei, beta rays are high-speed electrons, and gamma rays are electromagnetic in nature. Alpha particles are easily absorbed in air. Beta rays are roughly 100 times more penetrating than alpha, and gamma rays about 100 times more penetrating than beta rays. The disintegration of radioactive atoms to other elements is very important. This is accompanied by radiation and as particles pass through gas ions are formed. The ionization of air and other gases by alpha, beta, and gamma rays provides a means for measuring through the use of ionization chambers together with special vacuum tubes.

Most of the work on the transmission of beta rays through matter was done in England from about 1908 to 1925. Rutherford and his assistants did outstanding work in the whole area of radioactivity. People more directly concerned with transmission and reflection of beta rays were Crowther, Wilson, Varder, Madgwick, Eddy, and Schonland.

Typical curves for paper, aluminum, tin, and platinum showing beta ray transmission (affected by scattering, reflection, and absorption) were drawn on a blackboard. The curve is not usually exponential, but depends on such factors as angular range of accepted rays, size and source of window, and ionization chamber design. The beta gage is affected by material. Absorption and scattering depend on basis weight, not thickness.

Beta gages were not feasible years ago because there were no safe and cheap sources of radiation. Today's reactors developed under the Atomic Energy Commission yield numerous suitable radioactive materials. Present-day gages usually employ Strontium 90 which gives off beta particles and practically no gamma rays. The latter rays are dangerous to human life. The disintegration product is yttrium, which also gives off beta particles. Strontium 90 has a 25-year half-life. The radioactive materials must be kept in a carefully sealed container. The device must be calibrated for the material used. For instance, a high content of a barium compound in a sheet of paper would affect the reading, if calibration had been done with filler-free paper.

The general mechanics of beta gages were described. This included the source of radioactivity and the ionization chamber. The effects of variation in the location of paper with respect to source and pick-up chamber were discussed. Also discussed were the effects of voltage and frequency variations and effects of basis weight range under measurement. The devices at present are more effective on high-basis-weight sheets than on light papers. The use of the reflection or backscatter principle was outlined. In this case the source and ionization chamber are on the same side of the sheet. Dr. Van den Akker reported that beta gages are sound in principle and are "here to stay."

ROBERT J. SEIDL, *Secretary*
Lake States Section

The DRAPER Felt
DRAPER BROTHERS COMPANY
CANTON, MASS.

DEINKING SEMINAR*

A Discussion of the Problems in Wastepaper Usage

The meeting of the Deinking Committee of the Technical Association of the Pulp and Paper Industry convened in Parlor C, Commodore Hotel, New York, N. Y., Feb. 18, 1952, J. J. Forsythe, International Paper Co., Chairman, presiding.

CHAIRMAN FORSYTHE: Members and Guests of TAPPI, it is a pleasure to welcome you to the deinking seminar which we are holding here today. I regret that we are somewhat crowded due to the fact that this meeting has apparently ballooned on us somewhat. We had about 65 advance reservations, and I am afraid we are going to have over 100 before we are through today.

I am glad to have so many of you come to this meeting, and I believe we have a program which you will find interesting. I do have a few announcements which I would like to make; first, that the TAPPI Deinking Committee has been circulating a questionnaire on deinking practices. The purpose of this is to assemble information for a monograph on deinking which is to be put out at a later date. I know many of you have already answered this questionnaire, but if there are some who haven't received copies of this questionnaire and would like to fill this out, I do have some copies of the questionnaire and I would be very happy to distribute them. The identity of the mill is held confidential and anyone who takes part in this questionnaire will receive a copy of all the responses after they have been compiled.

The next thing I have to announce is that the preparation of this monograph will entail considerable work and for this purpose we are going to set up a special committee to handle this project. If there are any people interested in serving on this subcommittee I'd be pleased to hear from them.

Then, of course, the real business that we are here for today is to discuss wastepaper quality. The purpose of this committee is to promote and investigate research and interchange ideas among TAPPI members. If there are any points in our deinking questionnaire which we have not covered, we would be pleased to have your suggestions. It is not a complete job, we realize, and your assistance would be appreciated.

A third section covering bleaching practices is still in the planning stage, the first two sections having covered deinking and defibering practices, screening, and washing operations. If there are any problems which our committee should or could be of assistance on we wish to hear from you.

Now to get on with our program. We have divided our program into three parts. The first section will cover the nature of current problems in wastepaper usage. The second, identification of troublesome materials in deinking systems, and the third, suggestions as to possible remedies for present conditions.

I am very happy to present W. A. Kirkpatrick, Technical Director of Allied Paper Mills, Kalamazoo, Mich. Bill has suffered in silence for a long time on these deinking problems, and I think that he has a few remarks today with which he would like to break his silence.

MR. KIRKPATRICK: I don't know how loud the silence has been, but I know a good many of you have been faced with the problem that our mill has been faced with in the last few years. The problem as a whole was stated by Henry Perry in his fine article in the *Paper Trade Journal* of January 4, I believe. Realizing that some of you may not have read that, I have collaborated with Jim Wise, vice-president and general manager of Kalamazoo Paper Co., in a restatement of the problem, and at the risk of being a little boring, because I must read this, I shall read it because I want to get through it as quickly as possible and yet I don't want to leave anything out. I always felt that anybody who read a paper or read anything that was prepared didn't know their stuff, but I assure you in this case that I do know my stuff, and I am sure you all are familiar with what I am going to present to you, but I would like to get it on the record.

* Presented at the 37th Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 18–21, 1952.

Deinking Mills Dilemma

W. A. Kirkpatrick and James A. Wise

IN THE face of dwindling forest reserves, the use of paper and paperboard and wood pulp products is steadily increasing, both on a per capita basis and as the result of a startling rate of increase in our population. Today there are insufficient standing timber resources to justify more than two or possibly three new pulp operations in this country; and Canada and Scandinavia are both faced with similar outlooks.

Currently operating wood pulp operations have had to adopt extensive and carefully planned reforestration programs in order to insure pulpwood for future use and means and methods are being continuously sought to use less desirable species. This latter program has met with some success and may be counted on to supplement our available supplies of wood pulp fairly substantially for certain purposes in the future.

By far the most effective "ace-in-the-hole" the paper and paperboard manufacturers have in view of the present and future unquestioned shortages of vital fiber is the use of wastepapers. Roughly, the reclaimed fiber used in these industries amounts to nearly 35% of the total fiber used or approximately 7 million tons annually. This staggering figure can be readily comprehended when it is pointed out that it represents about 10 million cords of wood.

Were the use of reclaimed fiber to be discontinued or even curtailed for one reason or another, the shortage of paper, paper products, paperboard, regenerated cellulose films, and fibers, etc., would create hardships beyond imagination to an economy which has its very foundation set deep in the supporting structure of these products.

The use of reclaimed fiber may be roughly classified in two major groups. The first in terms of tonnage would, of course, be that which supplies the millions of tons to our tremendous paperboard production. Without the use of wastepaper in board production the packaging of goods and materials would face a crisis, and the distribution economy would collapse in short order. Moreover, paperboard has supplanted in substantial measure the use of scarce steel in many directions and is doing a very creditable job. A return to the use of steel containers would further aggravate the unbalance that currently exists between the supplies of steel available and even the normal demand for the commodity, while under our current program of rearmament and sus-

W. A. KIRKPATRICK, Technical Director, Allied Paper Mills, Kalamazoo, Mich., and JAMES A. WISE, Production Manager, Kalamazoo Paper Co., Kalamazoo, Mich.

tained production of civilian goods, a reversion from paperboard to steel would be a calamity.

Fortunately, the problem about to be discussed concerns the major user of reclaimed fibers to only a minor extent, but to the second user of reclaimed fiber, those who deink and bleach the waste for the production of white paper, the problem is a very real one. Stated in a few words, the deinking mills, who annually reclaim and use about 600,000 tons of fiber from wastepaper, are facing the possibility of losing this source of fiber completely because of the inclusion of deleterious materials in the waste which cannot be satisfactorily removed by any known method and which, if allowed to proceed in process to the finished product, results in one which is inacceptable to the ultimate consumer. If the mills who use deinked and bleached paper stock were to discontinue the use of this fiber and depend entirely on the available supplies of virgin wood pulp, the scarcity of printing and writing papers would be beyond belief. Moreover, there is no possible means whereby mills using virgin pulps exclusively could take up the slack. Prices would rise, unemployment in the country's fifth largest industry would be staggering, and if wood pulp production were stepped up in an effort to meet the increased demand, our forest resources would diminish at a rate which would shortly result in the Government taking over control of the wood cut quotas.

What more specifically are the deleterious materials coming through in wastepaper and just what is their effect on the economic use of this commodity?

For a while in the early years of the past decade, it was felt that the greatly increased use of groundwood in publication printing would present an impossible hurdle. Technologically the problem was met in three ways. The items containing high percentages of groundwood were segregated by printers and waste materials dealers and often used in the production of lower grades of paper and, of course, also in paperboard. Sorted grades containing 10 to 20% of groundwood were deinked at low temperatures and the groundwood portion of the furnish was bleached by peroxide. In this manner, after a mild hypochlorite bleach, usable, very fine, bleached fiber containing some groundwood was produced. Third, by the chemical process of chlorination with gas the lignin was dissolved from the groundwood portion of the furnish, and subsequent hypochlorite bleach resulted in a fine bleached cellulose fiber, one which in some respects was superior to virgin pulp. Thus it is seen that one phase of the problem was met and adequately handled.

The second and more serious phase of the problem concerns the inclusion in higher grades of wastepaper of materials which cannot be removed by any known method. These materials generally can be classified as thermoplastic or rubberlike, mostly very inert chemically, but possessing the unfortunate characteristic of getting through the conventional deinking and bleaching system along with the desirable fibers.

The plastic materials were introduced because of their adhesive properties, as moisture or greaseproof barriers, or, in certain cases, as surface treatments to enhance appearance and improve scuff resistance. The first example to come to general notice was the use by several large national magazines of a rubberlike binding material which holds the signatures together as a body and the body in turn to the cover. This use replaced animal glue and for the publisher it had many desirable properties. This same adhesive likewise found wide acceptance as a padding cement. Unfortunately, when going through the deinking process, this adhesive melts and balls up and subsequently deposits itself all through the papermaking process ruining wires and felts and finally coming through as a black or colored gummy material in the finished product. It is conservative to say that this material cost the paper industry upward of 2 millions of dollars the first year it was widely used. To the credit of the du Pont organization it must be said that once they learned of the difficulty, they went to work and developed a satisfactory substitute for the adhesive which *would dissolve* in the deinking process.

One factor which some people find hard to understand is that as little as 2 pounds of rubberlike thermoplastic material can cause to be unusable 100 tons of otherwise satisfactory fiber. Things like Scotch tape, flying pasters made with rubber, heatseal labels, vinyl coated covers and labels, etc., all present a problem. It is not suggested that any waste materials dealers, no matter how diligent, could ever sort all of these out, but what we do ask is a program of cooperation and mutual recognition of the problem.

A typical example of what can be accomplished by cooperative effort was the case of the binding adhesive mentioned above. Another which comes to mind involved cutouts from bread wrap end seals. One mill has encountered these three times at a cost of about $15,000 each time. The last one occurred on stock received by truck late at night and immediately used. By the time trouble was detected, 100 tons of pulp were practically worthless. These end seals have a coating of a plastic wax together with a rubberlike material. Tracing back the load of waste, it was found to have originated at the Marathon Corp. It took only a telephone call to receive their assurance that this waste would henceforth be burned rather than allow it to reach the *ordinary* channels for waste paper.

Similarly many label manufacturers, when told of the troubles encountered when heat sealing waste is received by paper mills, have offered to burn this waste.

Actually, the percentage of waste papers containing deleterious materials is very small, but its effect on the economy of the deinking mills is tremendous. They *must* be eliminated and *can* be eliminated. The story must be told to those in a position to help. These are the printer, publishers, and paper converters. It is important to them whether they buy papers containing reclaimed stock or not that our supply of fiber be not jeopardized. It is earnestly hoped that a basis can be found without delay for a program which will correct this serious situation. There is a lot at stake!

Chairman Forsythe: Thank you, Bill. The second section of our talks today will be on the nature and the identification of these troublesome materials, and it will be presented by A. H. Nadelman of Western Michigan College. I have known Al for a long time, and he has been in this deinking business for a long time. I know he can give you some very practical tips.

Identification of Troublesome Materials in Deinking Systems

A. H. Nadelman

Objectionable materials are discovered in ever increasing quantities in systems designed for the deinking and re-working of old paper stocks. An objectionable material in this sense may be defined as any foreign substance appearing in the finished sheet after normal deinking and reworking procedures, or as any substance decreasing the efficiency and continuity of operations by forming accumulations in or on any portion of the deinking system, stock preparation system, or machine and machine system. The vastly expanded usage of synthetic polymers in adhesives, coatings, laminated products, and inks makes some systematic approach to the identification of troublemakers in the deinking process highly desirable in efficient mill operation.

Occurrence of Troublesome Materials

Potential troublemakers are frequently discovered when dirt specks or blemishes are seen in handsheets formed from laboratory deinking trials, using equipment and processes

A. H. Nadelman, Member TAPPI: Professor of Pulp and Paper Technology Western Michigan College; Kalamazoo, Mich.

designed to duplicate mill conditions. A constant check on raw material sources by this method can often prevent introduction of objectionable materials into the system. If not discovered in laboratory experiments the materials may first be noted in the finished sheet, again occurring as dirty or colored specks in the sheet. This condition is frequently accompanied by the accumulation of floating agglomerates or gummy deposits on the walls of chests or vats in the system, on the wire of the paper machine, on doctor blades in the press section, or on the first drier section on the paper machine.

Once a troublesome material has been discovered in any of the places mentioned above, identification of the offender becomes important for it is only after identification that corrective measures can be taken. Once the identity of the foreign matter is established, procedures may be set up for the elimination of the trouble. Certain grades of wastepaper can be excluded from the process. Arrangements may be made with converting plants or wastepaper dealers for scrap segregation, or for a minor process substitution to eliminate the offending material. In the case of troublemakers occurring within a mill on internal broke, process adjustments may cure the difficulty. In some cases, an alteration in the deinking process may prove to be beneficial. In all cases, however, identification is necessary if adequate corrective measures are to be taken promptly and efficiently.

METHODS OF IDENTIFICATION

As mentioned in TAPPI Standard T 445 sm-44, Identification of Specks and Spots in Paper, visual inspection of the spot is often helpful, and frequently sufficient in itself. Increasing the power of the eye with a hand lens or microscope greatly extends the use of this visual approach. With this system, micromanipulation or other mechanical means may be used for the isolation of foreign materials occurring in sheets.

Before attempting removal of the spots a few simple tests are often beneficial. For instance, immersion of the sheet in carbon tetrachloride will often show intense black or brown bleeding around the spots. This is usually an indication of the presence of asphaltic materials from laminated sheets or Gilsonite, a component in certain gravure inks. Pale colors may result from the presence of paraffin or microcrystalline waxes. An exception to this rule must be made in the case of certain "blown" asphalts. These materials may be oxidized to a point where they are no longer soluble in carbon tetrachloride.

Dark scale from the deinking system is frequently soluble in dilute hydrochloric acid, applied as a spot reagent. The method for the determination of iron particles in paper or paperboard disclosed in TAPPI Routine Control Method RC-53 is quite useful in estimating rust or iron in the finished sheet.

Colored inks are frequently detected by visual inspection alone under the microscope. Black spots suspected of being ink may be moistened with methanol. The methanol will dissolve the blue toner usually associated with these inks leaving a faint blue fringe around the spot. Carbon blacks without toners are usually soft and friable, smearing or smudging under the pressure of a thumbnail or microscope probe.

Synthetic or natural polymers may occur as dark rubbery spots, easily deformed, yet resilient. Certain other polymers causing trouble in deinking systems may appear as resinous materials of a harder nature. Identification of these spots or of accumulations of these materials collected from the deinking or machine system is one of the problems frequently encountered in current deinking practice. This usually requires isolation of some of the material in question.

Identification of Polymers

A rough determination of the physical properties of the isolated material is an effective first step in the identification process. If the material seems to be rubbery in nature, procedures outlined in A.S.T.M. Standards on Plastics (*1*), Identification and Quantitative Analysis of Synthetic Elastomers, are usually sufficient for qualitative analysis of elastomers.

If further identification is necessary, or these procedures are not specific, a rough determination of specific gravity s often useful in limiting the possibilities. A simple procedure for this purpose consists of using kerosene, water, and a salt solution of given density for determining the range of specific gravity of the sample. As a precaution, it is frequently helpful to add a wetting agent to water or aqueous solutions so that misleading conclusions will not be drawn on the basis of samples "floating" due to the surface tension of the reference liquid.

In the case of clear samples the index of refraction may frequently be determined microscopically by the methods described by Chamot and Mason (*2*). This involves the use of reference liquids with the microscope.

Solubility of the resinous material in a series of organic solvents is also helpful in limiting the possibilities. Excellent charts for determining the significance of data dealing with these physical characteristics are included in the Modern Plastics Handbook (*3*). This reference is also a good source for the significance of many of the chemical tests which may be applied to plastic materials.

Chemical Tests

If an identification has not been made on the basis of tests previously mentioned, a more extensive chemical investigation may be necessary. It is desirable to avoid this procedure since the samples available are usually heavily contaminated with interfering materials. If a reasonably uncontaminated sample is available, or can be obtained by the use of suitable solvent separation and purification, the procedures given by Shaw (*4*) provide an excellent systematic scheme for identification, plus a number of charts and spot tests which are extremely useful even when the systematic procedure is not rigorously followed.

SUMMARY

Increasing quantities of undesirable materials find their way into deinking systems with current developments in converting and paper manufacturing techniques. Identification of these compounds is frequently necessary before steps can be taken to eliminate the problems they may cause in the deinking or papermaking process. A workable approach to this problem is outlined, and specific source references are presented as an aid in this identification.

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CHAIRMAN FORSYTHE: Thank you, Al. For the benefit of some who may have come in a little late, I would just like to say, I am very, very sorry we apparently oversold this meeting. I hope they will still bring in a few more chairs to accommodate all of you. The second thing I wanted to remark is that we are going to have these papers first and then we will have discussion immediately following all of these papers.

Now, the third paper. You all, I believe, know Fred Goodwill, the manager of the St. Regis Paper Co. at Kalamazoo. Fred will speak on, not only the nature of these problems, but on the possible remedies for this condition.

MR. GOODWILL: Thank you, Jim. I am the low man on the totem pole with the usual results, somebody else said it first. However, I hope you will bear with the repetitions that occur. They do serve to illustrate the point that our thinking is along the same lines, and the title does continue the theme song expressed so far, "Cooperative Effort Can Improve Wastepaper Quality."

Cooperative Effort Can Improve Wastepaper Quality

F. C. Goodwill

DURING the past few months, whenever two or more users of wastepaper talked together, the conversation usually sounded something like "*You* got troubles! . . . Let *me* tell *you mine!*"

It soon became apparent that everyone had at least one thing in common—trouble. The situation came to a boil and resulted in a meeting of representatives of consumer mills at Kalamazoo on Sept. 27, 1951. For the benefit of those who did not participate in the meeting, a résumé seems in order. Those present represented 12 mills consuming a total of 30,000 tons per month of the book and ledger grades of wastepaper. More mills have since added their support. It is felt that this is a gage of the seriousness with which the problem is regarded. The discussion that took place was not limited to any single aspect since among the group were mill managers, superintendents, and purchasing agents, as well as technical men.

Out of the discussions came these conclusions:

1. That the consumers alone could not solve the problem.
2. That a revision of grade standards and probably the introduction of subdivisions in some categories were indicated.
3. That a program of general education as to what constituted undesirable materials was in order.

To get the program under way, a committee of three, consisting of a technical man, a production superintendent, and a mill manager was agreed upon. This committee submitted an outline of its plan of operation to the top management of all mills that had expressed an interest in the program and requested approval. The approvals and assurances of support were immediately forthcoming.

The aid of the Deinking Committee of TAPPI was solicited to carry out the matter of general education on troublesome materials. This committee agreed to act as a clearing house for all information that was submitted. It also made arrangements for this meeting today.

On the matter of grading and for purposes of a general discussion of what was thought to be a mutual problem, attempts were made to arrange for a meeting between representatives of the Waste Material Dealers Association and the committee representing the consumers.

It was encouraging to learn of the dealer representation that was to be present here today. That there should be a lack of interest on the part of the dealers is inconceivable since it is, after all, the dealers' product that will become subject to increasing rejection on the part of the users unless the present situation is improved.

This is contemplated: As troublesome materials become known they will be traced to their source through the dealers.

Then: If the material can be altered or another substituted, the producer should be encouraged to make the change.

Or: If no change can be made but experiments indicate that the fiber can be reclaimed by using a different deinking process, then a market can probably be found for the waste, provided the paper containing the troublemaker is sorted out and baled separately.

Finally: If no change can be made and the fiber cannot be reclaimed by different treatment, there is only one alternative—burn it!

In any case it must be kept out of shipments to mills as it has been proved that only a small amount of a troublemaker means spoilage of a lot of paper when the waste containing it is converted to pulp.

In some instances, the bookbinder-publisher-printer will be able to get cooperation from the supplier of the troublesome material. For example, some manufacturers of hot melt resins for bookbinding have changed their product so that it is alkali soluble. In another case a large printing firm changed from a troublesome latex to an alkali soluble adhesive when it found it could not guarantee to keep flying pasters out of its waste.

To come back to the matter of grading. This might perhaps be more properly called "sorting" since in the past the type of fiber determined the grade but today fiber is less important than the processing to which the paper has been subjected. For example, label stock to which a special synthetic adhesive has been applied, or posters printed with fluorescent inks. That dealers have been confused is not to be wondered at since often what has been "meat" to one customer, has been "poison" to another. For the time being at least that must be worked out with the individual customers. However, better packing must come into being or a dwindling market will result.

When it is said that dealers must work out their packing problems with the individual consumers, the thought was that the consumers could ease the lot of the dealers and help themselves by instituting more uniform processing methods.

Whether deinking operations have kept pace with the times is very much open to question. A lot of hocus-pocus has existed in connection with something that is essentially nothing but a laundering operation and a thorough airing and exchange of ideas seems to be in order. For instance, isn't batch operation preferable to continuous in that it offers greater flexibility of treatment? Screening is one phase that seems to have been sadly neglected. Washing is all too often inadequate. Centrifugal cleaners can be made much more use of, etc. A modern deinking plant should be as well equipped and operated as a pulp mill instead of being the "hell-holes" that they have been all too often—and some still are.

Of course, the problem is not going to be solved overnight for, as Perry pointed out so clearly in his editorial (*1*), the situation has come about because of technological advances and technology is not standing still. Also, there is a lag between any change and the effect of it being apparent to wastepaper users.

This is a rough outline but it is hoped that it does point out that a concerted cooperative effort is required and, if adhered to, can improve the situation. It should be said that there has been no intention of fixing "blame" on any group. In fact, "blame" can only come in for consideration if the move fails, and if there is a continuance of the interest that has been shown to date, it does not seem that there can be anything but success.

F. C. GOODWILL, Plant Manager, St. Regis Paper Co., Kalamazoo, Mich.

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DISCUSSION

CHAIRMAN FORSYTHE: Thank you, Fred. Before I turn the meeting open to discussion, there are two things I would like to do. We have a number of mills represented here today, and just for the sake of curiosity I wonder if the mill men would raise their hands, not to identify themselves individually but just so we may have some idea of how many different mills are represented here.

How many of you mills are deinking as compared with board? I think we have a pretty good split. Of course, there are a number of board mills that also deink, too.

The second thing I would like to know, I would like to see the hands of the wastepaper dealers present. I understand there were going to be 16 or 18 different wastepaper dealers represented. I wonder if they would mind raising their hands now. I think we have a pretty good representation here today.

We also have a number of suppliers of these adhesives present. I know of at least six or seven companies that were going to be represented.

I wonder if they would mind raising their hands, please. I think we have them here all right.

Now, there is one thing I would like to do. You have heard from the mills represented here today. I think it is only fair that we give the wastepaper dealers an opportunity to express themselves right now. I would like very much at this time to call on Dave Dickson of Penn Paper and Stock Co. and ask him if he has any comments he would like to make.

Mr. Dickson: Well, in front of this august body and being the subordinate of your industry, it is difficult to know what approach to make. We are told we are going to be out of business. However, we have done some research, too, but it was mostly by word of mouth rather than by application. And if we can't find any other use for our product, being on the defensive, one fellow told us we could have molasses made out of it. So don't get too independent.

It has seemed to me that all of the talks and all of the conversation has been "after the damage is done." Now, we were aware of these difficulties you were having, and our experience was very costly because, of course, everything that happens we pay the freight on it in a small way. We think we pay it automatically, but when I hear of $15,000, and 2% contamination, it would indicate that we only pay a small percentage of the damage that may be done. And when we hear about segregation, well, what do you expect from us? You can't tell it yourself until you have these papers processed. You have to use carbon tetrachloride, you have to use this and that. What are we supposed to do? We are just people, and there is no way that I know of. Of course, as you probably know, the help that grades the stock comes from Bryn Mawr, Vassar, and Wellesley, and when you start to give them the kind of talk you handed to us, you might as well forget about it. But you have to go back a little further than that. Our thoughts are somewhat different. We can only do what we can do. If a mill wants to put some kind of latex in the coating and spread it out over the country and it comes in to us, there is no way in the world we can sort latex coated papers from any other papers. If it gets back into the individual mills that produced it or some other mill, what can we do about it?

It seems to us that all of these things should be eliminated at the source. Of course, wastepaper is never considered until you come to a crisis. The flow is so even and so smooth that unless something unfortunate or unforeseen might develop or some critical situation might develop wastepaper is not considered. With the producer, and I understand there are some producers here, the junky is somebody who goes in the cellar window and pulls out whatever refuse he can. The paper dealers receive no consideration, but if they find their pocketbooks are being pinched to the extent of a half million or a million dollars a year, then maybe they might consider the factors that enter into the re-use of wastepapers; namely, latex lining, latex adhesives, synthetics of different kinds, asphalt, and so on. They should consider all of those things before they go into a project. That is the source of your trouble. If enough publicity is given—I am not criticizing anybody, I am just talking—if you want to get to the evil you have got to get to the root of the evil. We have been trying over a year and a half to have a meeting such as this to get together with somebody who would talk this situation over with us and help eliminate it. After all, we are not stupid. We are stupid enough, but not too stupid. We know that if the market for our materials dries up—once again I don't want you to get too independent—and our materials are no longer usable, we are not so stupid that we want to just let it go by default. It seems to us, if I have the consensus of opinion, that maybe we should get back to the source of synthetic inks, if they are not usable, through an advertising campaign and let the publishers know that the ink they are going to use should first be submitted to TAPPI or some other technical organization—to see whether it is usable and whether it is going to cause damage in the reprocessing of fibers.

If anybody is going to make latex and use it in their processing or bindings, why not get in touch with TAPPI. Let's publicize it. You have available at your fingertips an organization that can be of immense assistance as it can be in every plant in the United States inside of one week advising them of the situation. With the prestige your organization has, perhaps it might bring to a consciousness the fact that the waste is no longer worth a quarter to a half million dollars a year if they use the things that are harmful in papermaking. After all, this is part of their product. It is not our product alone. After all, we are only the people who take what we get. We can't order them to make a certain kind of wastepaper. But on the other hand, if they want to obtain the revenue from wastepaper, which in some cases represents their sole profit, let them know that their sole profit depends on the kind of product they produce and how it is delivered to the wastepaper dealer.

With just these few remarks—I don't wish to go on too long because we have other people here who want to speak—I would like to throw the meeting open to our side of the fence. I understand there is a tripartite here, the people that produce these adhesives, etc.—we don't want to put them out of business. We are people ourselves. We are in business. We don't want to hurt anybody. Maybe they can adjust their formulas to conform to your ideas of what is usable and what is not usable.

Chairman Forsythe: Thank you, Mr. Dickson. I used to work for a completely self-integrated company in the paper mill, and whenever we would have any troubles we would always blame the pulp mill and whenever they had any troubles they would always blame the wood supply department and the wood supply department would always blame God, but I think we are in a little more fortunate position than that today.

I know we have a number of suppliers here today who have worked very earnestly on this problem. The real purpose of our meeting today is to publicize and enlist the support of all the people who are responsible for this condition, not directly responsible in all cases, but who have something to do with making this the problem that it is.

I have found, personally, in dealing with a number of these suppliers, that they have been very anxious to cooperate. I am going to call on one of them, not because he represents the company that has done perhaps the most good, but one that I am familiar with, who I know have worked on this problem. I might say I know the companies like du Pont, National Adhesive, Illinois Adhesive, Manhattan, are all working on this problem. They have all attained some degree of success. The man whom I have happened to have more contact with than perhaps any others, I believe, is here, Frank DeFranco. I would like to have him speak on a few of these problems as a representative of the adhesive companies.

Mr. DeFranco (National Adhesives Div.): Well, I am not prepared to say anything today except that I have been asked to represent the adhesive manufacturers—I happen to work in the development department in my firm. People who use adhesives come to us continuously, and say to us, "We are using an adhesive. We would like to speed up our method of production. We have developed this machine.

Now your adhesive presents this problem. It doesn't dry fast enough, or, what properties are required to fit in with this new piece of mechanism?"

I am going to speak specifically about a product that has caused you a headache but now we are glad to say it is alkali soluble. Technologically we have advanced to the point where we have helped the printers and the binders in this country to the point where they can make perfectly bound books at prodigious rates, so much so that in these days of inflation they have reduced the price $10 per thousand, which shows that they are willing to pay more for adhesive that does more.

But in turn, this adhesive gave trouble to the people who bought the waste. Now that has boomeranged. The people who sell the waste, who often figure their margin of profit on the amount of paper they sell, had the problem boomerang on them last September and it behooved them to find out what they could do with the paper that they contaminated with the hot melt that they originally asked us to develop.

So we put our heads to that job and fortunately came up with an answer. We knew that this was a problem 2 or 3 years ago. However, it wasn't made known to us or they didn't tell us definitely that it was going to cause all this trouble until wastepaper wasn't as scarce as it was before.

Here is what we would like to do. We, as development men in our firm, would like very much, to help not only our customers, but our customers' customers, and we welcome any problems that you people have. That is, if you buy some waste material, and in buying that wastepaper there is any trouble with a product that we make that is in that wastepaper, let us know about it and we will, as development men in the laboratories of the companies making the products, modify those products in a way we know will help. That is the way we hope to serve you and serve ourselves, because we don't like to be made to feel that we helped one segment of an industry and then an industry that works with that industry is hurt because in turn we may suffer and lose part of that business.

Now, I don't know what questions have come up in your minds about resins. I have had quite a bit of experience with the various binders and printers in this country, not so such with the printers, but binders, and they use resins in various forms. They use it in the lacquer form, they use it in the emulsion form, and they use it in the hot melt form. We have been successful in making the hot melt form alkali dispersable. Incidentally, that hot melt is only used, as far as I know, for perfect binding and I think, there only are five manufacturers of that kind of book in this country. However, they are big manufacturers.

Now we are given the problem of trying to make alkali dispersible the resinous material they use in flying pasters. We are going to lose our shirts because we will make this product alkali dispersible and maybe sell five gallons a month to a printer. But, we are tackling that problem.

Are there any questions as to what resins are used in these different products that might help papermen identify them?

Mr. Dickson: Are there any resins you can use that are usable by the paper mills in these hot splices, in these fast presses?

Mr. DeFranco: As I said, we are working on that right now.

Mr. Dickson: Have you come close to a solution?

Mr. DeFranco: I think we can come to a solution on that one. That doesn't sound insurmountable because it has a vinyl base similar to that we use to make the hot melt. It can be utilized to make an emulsion form of the same material, I think. We are working on it, and we are not too far away from a solution.

Mr. Dickson: Would I put you on the spot if I asked you if there is something else you could use that might do the job?

Mr. DeFranco: When you are to do a job you don't look at what trouble you are going to get involved in first. You do the job and then you worry about the trouble later. That is the fault of the printer. They find something, it is fine, it works. Then when they get into trouble they want to get out of it. That is the unfortunate way we have done things. Maybe we progress a little too fast, but again that keeps fellows like me working.

Chairman Forsythe: These flying pasters, do any of them use polyvinyl isobutylene?

Mr. DeFranco: I couldn't say. Not the one or two we make. I can only answer for my company. I wouldn't be surprised, though.

Chairman Forsythe: May I interrupt you for a moment? For the purposes of this meeting, we would like to get this information as widely distributed throughout the industry as possible. In order to do that I would appreciate it very much if you would give your name and the company you represent.

Mr. Potter (Illinois Adhesive Co., Chicago, Ill.): We have, I think, probably the majority of the flying paster business, other than rubber base, in the country, and I may say that we have definitely solved the problem that you are talking about. It has been tested and proved.

Mr. Bradbury (Mead Corp.): When it comes to the problem of whether we have solved or whether we have not solved the problem of these sensitive adhesives as used in flying pasters, the question I would like to ask is, what is the test as to whether this has or has not been solved? Now I will go a little bit further. I am not asking the question this minute, but you can answer after I sit down, please. The point I want to make is this, that we have found that the usual test that is made is not sufficient. Jim Forsythe has issued a list of different magazines, for instance. He has tested these magazines and he says certain ones are dangerous and certain ones are not dangerous. Now the question immediately arose, when I showed that to our research department at the Mead Corp., what test did he use to prove this? So I asked him this morning and he said, "Well, we took this material and added caustic soda solution in the normal method of dispersion in the laboratory and then we made up some sheets. When the sheets were made, if they didn't exhibit some sticky spots in them, we said it was all satisfactory.

Now it is our firm belief that this is not a sufficient test for the reason that we have frequently made stock to such an extent that you can find no sticky material whatsoever in it. We run it off over a paper machine. There is nothing that shows up in the screens, nothing that shows up in the wires, but when the paper strikes the drier cylinders the change in temperature causes apparently a breakdown of the dispersed suspension of these plastic materials, in particular polyisobutylene and similar synthetic rubber materials which are used in flying pasters, etc. Those materials, apparently completely dispersed up to the point where the paper hits the drier, comes out, and you get a tremendous quantity deposited on the driers. That is very, very objectionable from that point on.

Now, I don't know how a laboratory test is going to demonstrate that some of that material is present in the stock. Up to now our test doesn't show what will happen on the paper machine, and I don't know for sure that an adhesive manufacturer is capable of demonstrating that they have solved the problem.

Chairman Forsythe: Thank you, Rolfe. I think we are all very interested in that information. We think that from time to time we have found a number of materials which cause us no trouble and then about 2 or 3 months afterward we get a complaint from one of our customers and we find that we have had some sticky spots in the paper we didn't realize we had. On checking back we think that we had gone all through our magazines and all other materials that we know of, but we always find that there is something

we haven't put our finger on. Perhaps Rolfe has given us some additional information that we can use to advantage today.

I would like to call on Mr. Stouroff of the Buffalo Wastepaper Stock Co. and ask if he has any comments he would like to make.

Mr. Stouroff: I can't talk on this subject from the technical aspects. However, I would like to say a few things about it from the dealer's point of view. A lot of mills, when this thing first came out, said to us and to other dealers, "Why can't you fellows sort this stuff out?" So I came loaded with reasons why we can't sort this stuff out. I don't know, I suppose all of you have seen these things, but these are typical samples of what we are supposed to sort.

These sheets are from magazine publishers' stitcher's waste. They were interleafed with printed material, and one happens to be colored, but there are a number of these sheets, some of which are free of adhesives, others are like this typical sheet. I suppose you have all seen it. This sheet has the synthetic latex. Some of the others have the hard plastic. Now, these are mixed with sheets that do not have any adhesive and so are impossible for any dealer to sort. They would have to be handled piece by piece and that will result in a furnish cost that would be quite sizable to say the least. That is just the white waste.

Then we run into some other items like this which is a laminated sheet with a coating on one side and has a tacky substance in the center for the adhesive. When you get this mixed up with other waste, it is almost impossible to sort.

Now, these are our problems and yours, and I just want to say this for the dealers, they are perfectly willing to sort and pack the paper stock so that it can be used. After all, that is their business, but some of these things are just impossible from the dealer's standpoint, and they can only deliver to the paper mills that paper which can be produced by them. We are perfectly willing to cooperate in any way that we can but we feel that there is very little that we can do on stuff like this. It is a technical problem that will have to be worked out between the consumers of the paper and the converters who are using these materials.

Chairman Forsythe: Is Ronnie Hynes or Dwight Stocker here? I wonder if they would care to make any comments.

Mr. Hynes (Newton Falls Paper Co.): I have no comments to make. I am encountering the same problems along with everybody else.

Mr. Stocker (Michigan Paper Co.): I have no comments to make.

Chairman Forsythe: Anybody here want to venture any opinions right now?

Mr. Kirkpatrick: I think Mr. Stouroff has come right to the point in that the mills cannot expect the wastepaper dealers to carry this load. It is an impossibility. It is an impossibility because they can't detect the stuff and we have to get back at the source of the trouble which may get back beyond the converters and publishers to the adhesive manufacturers, but if the publishers and converters were familiarized with the difficulties that the mills are encountering, I feel quite certain they would cooperate to the extent of eliminating this type of material in their waste, and that would go for wads of ink and things like that, too.

I am sure every mill that is represented here has encountered fountain waste where the printer at the end of the week, at the end of the run, or at the end of the day will clean out the fountain, slap in quite a big punch of paper, roll it up and throw it in the waste. You might have 2 to 5 pounds of ink in one single wad. Even though that ink may be readily dispersible as a film on the sheet, when you get a wad amounting to anywhere from 1 to 5 pounds of ink, it is almost impossible to disperse it satisfactorily in the deinking system. Here is a bunch of lovely looking labels. I don't think that any girl sorting paper in the world would ever throw these out as being unsatisfactory. I will pass some of these around the room and if you just touch a match to the back side of them you will see what that label will do when it gets hot in the deinking system. It has a rubber base on the back which immediately becomes a sticky gummy mass. It eventually adheres to the papermaking equipment. It certainly is beyond consideration that the wastepaper dealers could ever get that out of the waste. We don't ask that. I think we will have to get back to the point where we have some sort of a program with the publishers and the converters.

Now as far as identification of these deleterious materials is concerned, even though Brad said that laboratory processes are insufficient, they are at least a step in the right direction. I don't feel quite as strongly as he does that we should throw out the idea of using a laboratory or many laboratories as the basis for judgment. I think that testing should be done, at least as a first step, and for my part I propose that some group be set up, and I am sure the waste materials dealers have made the same proposal, that would be available to test materials which are questionable on a laboratory basis and determine whether or not they are satisfactory. In the laboratory you can tell which materials are not satisfactory at least 95% of the time. Maybe the other 5% is dangerous, but if we can only get 95% eliminated we would be happy, and that would be a step in the right direction.

Mr. Bradbury: I don't feel that the laboratory tests are at all in vain. I feel quite certain that they are very important, but I want to point out that we cannot use them as the last word. The adhesive manufacturers can't make an adhesive and say, this is okay, we tested it according to some procedure and that proves it. It is a warning. Too many times we are tied up with misinformation and tests which are not conclusive which create misunderstandings among the users. Jim has produced a list of different magazines which he found had bad adhesives in the binders. We talked to him and found out how he made the tests. The interesting thing about it is, that as far as I can estimate, 75% of those magazines that are bad insofar as weight of fiber was concerned came from just one big concern. There is also another list which was not included—I don't know why he left it out as he knows about it—the pocket books which are of some importance.

I have a letter here which was obtained by some of our sales service people who go around and contact our customers and find out about their problems. In this particular letter—I am not going to read it, I am going to tell you about a few things that are in it—first, they say that apparently the Mead Corp. alone is way, way behind the rest of the industry because everybody else can use these adhesives in bindings, but the Mead Corp. can't.

Well, from my contacts around through the wastepaper users, I think we are having considerably less than the average amount of trouble from the use of these heat set adhesives.

In the second place, they said that we didn't cooperate in the beginning with one of the companies which developed this adhesive, and we have in our files a continuous stream of exchange of letters between this developer of a certain heat set adhesive and our company in which we pointed out the way. This other concern went ahead and developed a dispersible heat set adhesive. We thought that they would have no trouble. As a matter of fact, our tests were based upon the same sort of procedure that Jim used. In that particular case we thought it was probably okay. Polyisobutylene is the one which is most critical with regard to this unexpected result of thinking you have something and you haven't.

Now, then, the next thing I find is that a magazine which is well known to all of you, a very large bulk magazine, recently changed over to adhesive that was apparently all right. Then this company said that they had developed a new one and this was going to correct everything and from

now on we were going to be in fine shape. They sent us a sample of that adhesive and its formula. We checked it and we suspected it would be very bad, and we come here today and I find that this particular magazine, this company, has gone back to one of the very bad adhesives. I don't know because I haven't checked the magazine. We predicted it in the laboratory before it came along. So we have a man who is responsible for the development of these heat set adhesives who acts upon information which is faulty to start with. He says, "We will take this new one. It is going to be okay." But he didn't check back to the source which he should have if he wanted to be sure. He probably would have found that we wouldn't recommend it.

As far as I am concerned, any material used as an adhesive that contains polyvinyl acetate or polyisobutylene is immediately suspect, and I don't care what you put in it.

As a matter of fact, I have not gone back to this company, but I will make a personal contact and try to get them to straighten it out. I didn't want to do it until after this meeting when I might have all of the information available as to what you gentlemen as a whole think about it. If we can convince them then to have these adhesives checked before they go ahead, it is possible we will get the whole thing swung over on this particular group of magazines which in my opinion cover 75% of the weighted fiber for magazine stock that causes our trouble. That doesn't have anything whatever to do with ledger. I personally am not mixed up with ledger but I think ledger is a problem entirely separate and distinct from magazine bindings.

CHAIRMAN FORSYTHE: Is there any user of ledger stock here who would like to make some comments about the problems on ledger?

MR. CONNOR (W. C. Hamilton Co.): I think this is a wonderful opportunity to get this thing aired, but I am a little bit disappointed at the rather pessimistic view we are taking. We certainly have the same problem confronting us and I don't think it is insurmountable. We have to take into account that there is a lot of paper on the waste dealers' shelves right now that is already treated, and I don't think they are going to burn it. So I think we have to look at it from the standpoint that we should do something to sort through the paper they now have. I don't believe that, if we know that there are Bromo Seltzer labels or a great many others that we have already identified as being bad actors, we can't take those out or that the bales containing those can be thrown out without rejecting the entire shipment. I, therefore, would like to submit to the users and also the buyers that possibly we can work a little closer on this problem and eliminate some of the difficulties with which we are all confronted.

I would like to also substantiate what the previous speaker said about the matter of the isobutylene or any of those polymers. If you have any of them, I don't care how small the quantity is, in your mix, you are going to have trouble before it gets off the reel and I think we have got to start with that supposition.

JAMES WISE (Kalamazoo Paper Co.): We are like Dickson, we are just ordinary people at our place, and we have had a lot of trouble, but I am quite optimistic about the magazine end of the thing and the things that have been said. There is one very large publisher who puts out two magazines in his line which are flat bound. He has never used an adhesive which bothered us at all. I don't know whether it is because of his very close association with a paper mill or not. So from the long-term view maybe the magazines will come out all right.

Then you go from there to these various laminated materials and heat sealed labels. It seems that every well-known pharmaceutical house in the country is printing their labels on this material. We have had Abbott, Upjohn, and Parke, Davis in the last 2 or 3 months.

From that you go to die-cut labels that may be clapped on a couple of cupcakes in the corner restaurant across the street from the mill. Fortunately because of the end use of the things themselves they don't come back as wastepaper. It is simply the printer's or converter's waste.

Assuming that something can be done through TAPPI and other agencies to the magazines, can't the wastepaper dealers say to the printer "Bill, we can't use the stuff if you include heat sealed labels in the rest of your waste. If the board industry can't use it, burn it up because otherwise it is going to interfere with the sale of the rest of your waste." If wastepaper dealers do that and the paper mills do it, too, I think we will get somewhere.

I think the third item is padded forms. In the small town of Kalamazoo there are probably 15 printers who will make up 1000 to 10,000 forms, pad them on the back, and cement them. I don't know how the devil you are going to get at that because certain dealers we have had have just torn the sheets off those pads which leaves shreads of material on the sheet and you are still lost. I would think that on the heat sealed die cut trimmings and shavings, if either the paper mills or dealers could get the point across to the people who handle and produce those things that the waste isn't any good, it would be to their own benefit to keep them out, wouldn't it?

MR. DICKSON: I would like to answer that. It is not alone the users of paper and those that come to an end product of waste, but I think the mills themselves. For instance, latex coatings, who can tell latex coatings?

MR. CONNOR: That is why I want to narrow the field. There is no use of talking about everything.

MR. DICKSON: We have got to formulate an idea here somewhere. During the past year I would say a minimum of $480 to $500 million was paid out to producers of wastepaper. They can't laugh that off. If they can, they are pretty rich. Some outfits, as I said, depend on their waste paper for profit.

I think the fundamental idea and the first objective of this meeting should be to educate every user of paper and every converter of paper to the idea that if the items he is now using are not suitable for re-use and for re-conversion into new fiber—if that is not the idea of this meeting then we are wasting our time.

We have been waiting a year and a half to get together with you through nobody's fault that I can understand, but here is a case where an envelope manufacturer has shipped in wet strength. It is the same weight, same appearance. He converts it, puts it into waste, and it shuts a paper mill down. He ships another bunch and he shuts the mill down again. Now, if that envelope manufacturer is not aware of the difficulties that he can cause, and understand the envelope manufacturer today is getting a real price for his waste, in some cases in days gone by, not too far gone by, he actually received more for the waste than he paid for the new paper, he certainly should be made aware of what he is getting in his paper and what happens when he puts that stuff into his waste.

I just heard you technicians talk about the fact that you have to wait until it gets to the mill and you try this and that. When we are picking up a piece of paper to grade we can't stand by and wait for a laboratory test on it. The education has to be done right from the very beginning and from the source. If he puts certain things in the paper he should consult you people especially if he is going into something that looks like latex inks. We have one account which is about ready to go into latex ink in one publication, but it will cost them $10,000 if they use it. Well, now, they think tw ce. Fortunately, in this event they called me and sent a sample which I sent on to the laboratory. It came back as latex ink, and, of course, I told them, all right you can use it, it is none of my business, but I don't think our people will take it.

They have to be made conscious of the fact that if they

want to sell their wastepaper they have to consider whether it is usable or not and whether the mills will accept it. That is where the education must begin, and you have right available to you now, among other things that you folks have, the mechanics to spread this information all over the United States. We are very happy and willing to join you in spreading this information.

Mr. Kirkpatrick: I would like to answer two of your questions. You mentioned a couple of times the use of latex and coatings. I presume you mean in mineral coatings. Ordinarily latex causes no trouble in coming through on the paper. Some mills have gone way, way up in the percentage in the coating, and as far as I know none of those mills have had any trouble re-using their own waste or waste that has come back.

Mr. Dickson: That waste gets back to us, and a mill using waste that could come back either in your printed waste or some of the white shavings, all of a sudden finds that they have a bad gum-up in their mill. We have had that trouble. I think every dealer has had that experience.

Mr. Kirkpatrick: You mentioned wet strength. If wet strength was all we had to contend with, I don't think the mills would be too much excited about it. To be sure, it does cause us headaches when we don't know it is coming through, just as it causes you headaches. No envelope manufacturer or other converter should buy wet strength and let it go through in the normal way, but those aren't the things that are costing us so much money every year. It is these synthetic resins that cause specks, spots, and sticky substances in our paper that are really the headache. It is not the wet strength. We can overcome the wet strength. Nevertheless any mill in the country can use wet strength paper if they know it is coming through. If they hit it and they don't know it is coming through it will usually ball up somewhere in the system and they have got to shut down and throw it out.

Mr. Dickson: It "ain't" the way I heard it.

Mr. Bradbury: I might say that padding cement does not need to be a problem if the adhesive manufacturers will manufacture it properly because very good magazine cement can be made with no synthetic rubber, polyisobutylene, or polyvinyl acetate or any one of those things, and it works very well indeed. I think the adhesive manufacturers can try to sell that thought to the makers of pads. If they do, I think we will get along all right.

Mr. Dickson: Once again, gentlemen, I don't want to dominate the meeting, but there are some things here. We have just heard about this business on the back of the pad. Now, of course, some of them could color it so that you can tell if you get hold of pad paper, but most times when it gets to the dealer it may be torn up into a number of sheets, just as some one else has said among you folks. I defy anybody to stand by and pick that stuff out and yet cumulatively it will cause a lot of damage particularly if they are making small sheets. You have those little globules of this stuff that comes to the surface in the sheet that drag the feed and the whole thing jams up. Sure you can color them. One of our people says the bag people make kraft and they are able to identify the kraft wet strength. Why can't it be done with plastics? Once again you come to the human element where it might get by. It gets by even though it is colored. In most cases it is folded among other sheets in the press, and it gets into the paper mill and you get into more trouble.

Chairman Forsythe: There is one comment I would like to make. We have had this problem on flying pasters. Some people have said they could sort and segregate this waste for us so that we would get shipments of white printed waste that would be entirely free of white pasters. Unfortunately, wherever you have a human element involved, as far as segregation and removal of these splices, it does not seem to be possible to do that type of thing, so I think it comes back to what everyone has said here today, that it goes back to the question of finding materials which in themselves will be perfectly compatible with the normal deinking practices.

One person mentioned here the presence of these pocket books. One of the adhesive manufacturers told me, and I think it is probably common knowledge that this past year approximately 1 billion pocket books were printed. That is approximately six or seven pocket books for every person in the United States, and of those billion pocket books that were printed, about 75 or 85% are now bound with hot melt adhesives, so you can see what a problem that is going to be in itself.

Mr. DeFranco: It is going to get worse, too.

Mr. Kirkpatrick: The answer is to hit the publisher and the printer.

Mr. Bergstrom (Bergstrom Paper Co.): It seems to me we are chasing a whale of a lot of animals of some kind around. It seems to me they are going to propagate and we are going to be awfully busy chasing them. I am wondering what the answer is in the long term. I think, at least as one mill, we are in this business of deinked wastepaper for many years to come, probably longer than I will live. I don't want to see us get into further trouble. I think you have got two aspects of it. We do not want to restrict the amount of paper that you are going to have for use.

First of all you have to go into an intensive program to find out ways of handling some of these things that are coming out so that you will not restrict the wastepaper coming in.

I am not so sure that any technical group couldn't devise a milk bottle that wouldn't use a paraffin derivative. If any of you know anything about the milk bottle business, it is the greatest user of fiber that I know of. It wastes this fiber simply because no effort has been put on it. That is an example.

I believe the papermills that are using deinked waste have some obligation to broaden the field of what they can use. The other aspect you have discussed at quite some length, and that is the proposition of a standard test. I don't know whether the rules and regulations of TAPPI can take that on or not, but there should be some organization which doesn't necessarily condemn the paper but says it will be difficult to re-use so that there will be some indication for the wastepaper dealer.

Then there is, of course, the angle of publicizing your results without threat, but merely selling to the people what the deinked wastepaper business means to them.

Now, a program that would encompass all those things is something that can't be settled here. It has to be started and it is not going to be anything that will cost a small amount of money, and it is not something that can be done today and disbanded tomorrow. It is something that has to carry on probably for ten years. It is going to mean a considerable amount of work and who is involved in it, of course, is a thing that will have to be determined. In other words, I don't know whether you want to include the wastepaper dealers and the plastics men, the printing men or magazine people, or what you want to do, but I do know one thing, if you want to start you have to start small and get going.

It seems to me we ought to look at the future instead of chasing a lot of rats around here because they are propagating awfully fast and progress will not stop. You are not going to stop these laboratories from having new things. They get a new idea and they sell it. It isn't the big fellows alone. You can talk to du Pont and those fellows around here. Those fellows are interested, but it is the little fellows who are going to bother you.

Chairman Forsythe: Is Mr. Uong of the Fitchburg Paper Co. here?

Mr. Uong (Fitchburg Paper Co.): We have more or less been thinking along the same lines that Mr. Bergstrom has

been thinking. We feel this problem is of such a magnitude it should be solved from as many angles as possible. There should perhaps be an industry-wide organization on the basis of so much contribution per ton from say wastepaper dealers as well as wastepaper consumers to solve this problem by educating everybody in regard to the types of materials that are troublesome in the deinking operation.

In addition to that there should be a program of research work to devise ways and means that will help to get rid of material once it does get into the system, accidentally or otherwise, and particularly at the present time when so much of the different troublesome materials have already gotten into the wastepaper stock.

For that reason we have approached one of the research institutes of this country, one of the foremost, the Batelle Memorial Institute of Columbus, Ohio. I shall be very glad to get together with any one of you or any group of people who are interested in having that particular research problem solved after the meeting or any other time during this convention.

MR. POTTER: How many of you men have really run onto alkali dispersible hot melt where the shavings were segregated and can make a statement as to whether it is or is not the answer to this hot melt binding program?

MR. KIRKPATRICK: I can. Pete Massey called in the du Pont organization on this thing originally about three or four years ago, and they developed a material which they thought was satisfactory and which we tested in the laboratory. I don't know what the chemical composition of it was, but McCall's made a run using this newly developed adhesive and sent us the trimmings and the waste from a whole run. We put those through the plant by itself and never had any trouble with its whatsoever. It never came on the wires, felts or driers, and we felt they had done a wonderful job.

Unfortunately, because of the times, they weren't able to put this material into full production, and a while back I gave them the devil because I didn't think their sales organization was any good. They didn't go out to sell this. I guess the problem was back in the manufacturing end and not the sales end. They had the thing developed as probably you have, and I feel quite certain that in that way at least we can get at some of the major sources of the difficulty. After you have developed a certain adhesive, I am sure any mill here would be glad to test out a large quantity of waste and keep it segregated through the mill in order to determine whether or not it is satisfactory.

MR. POTTER: We are pretty closely connected with the binding industry and we make both animal glue formulations and National does, too, and hot melt dispersible and non-dispersible. We are not convinced that the alkali dispersible material is going to be the complete answer. We are concerned with the possibility of not getting them segregated properly. I believe the Robert Gair Co. ran into that very thing in one of the Eastern plants.

CHAIRMAN FORSYTHE: Are there any board mill representatives here today? I know this represents a different problem in that the board mills do not normally work in the range of alkalinity that the true deinking mills like ourselves do.

MR. BOOTH (Robert Gair): We have made two runs of the same du Pont material in the beater run, and one of them was not satisfactory. The other one was very satisfactory. But it is our feeling we will have to change over our whole wastepaper receiving in order to segregate that, plus the fact that we will have to change over a good part of our process. Many times we have used a material in the furnish and had to use three times as much chemical in order to process it. So, until we can buy this material at the right price, until we can work it out economically, we don't want to see it.

MR. POTTER: That is the problem we are faced with and so are the other fellows. We have gone into a lot of expense to develop this basic material, to bring it out, and we are now trying to determine whether it is going to be a big program. I don't think you are going to be able to stop hot melt because it saves too much money in the binding operation as Mr. DeFranco says.

MR. FEFRANCO: May I add something, following the theme that Mr. Potter started. As of the first of February, all of our production, because we make our material basically right up to the monometric form, all of our material will be alkaline dispersible.

Getting back to the Robert Gair thing, for two solid years we sold one good customer lots of hot melt. Was the hot melt acceptable? They loved it. The hot melt was wonderful. There is a question I would like to get an answer to. For two years we sold this large account. I don't mean we sold him a thousand pounds. We sold him quite a few tons per month. We never got a complaint. The material never got clogged in the screen, never gave them one iota of trouble, and all of a sudden last September they wouldn't touch it with a ten-foot pole.

MR. GOODWILL: I think the answer lies in the reference I made to the lag. For instance, we are getting magazines in that are 5 and 10 years old.

MR. DEFRANCO: But you were getting the trim all the time.

MR. KIRKPATRICK: There you may have some difficulty in identifying the source of trouble. Many times something will give you trouble and you can't trace it down to source. Finally something completely unsuspected will be located, like I mentioned, as bread wrap ends. That took place in my own mill so I can speak with authority on it. We had an awful time locating what it was that was causing the difficulty because the back side of those little end seals look perfectly innocuous.

MR. DEFRANCO: If you are using hot melt for two solid years, you wouldn't let it bother you for that long without trying to pinpoint it.

CHAIRMAN FORSYTHE: I think the problem is this, you may find some sources and you may think you have discovered the cause of your trouble, but you still keep on coming into trouble and you keep on investigating further, and you may find that while you may have located some of the sources you still have other sources with which to contend. Speaking from our own experience, we have used publisher's waste which had flying pasters in it. We were tickled to death. We thought we were getting wonderful stock until we discovered that these flying pasters that were giving us all kinds of trouble and were probably a worse offender in our own case than magazine binders.

I wonder if Mr. Claghorn of Pioneer Paper Stock Co. is here, and if he would like to say something. We would like to have any comments he would like to make.

MR. CLAGHORN (Pioneer Paper Stock Co.): There are a couple of things that have impressed me very much. I think primarily the problem is similar to the patient who walks in to the doctor. I have a horrible feeling that it is rather futile to treat the disease until we know what the disease is. I wonder if our problem isn't first identification of the disease.

It must be hell for a consumer of wastepaper to take a bale from Dickson and a bale from Cherak and a bale from myself and toss it into a beater or into a cooker and then have trouble, and then treat it for small pox, scarlet fever, and itching feet all at the same time. I feel like some one else said here, shouldn't we take this step by step and first try to identify the disease before we start to treat it?

As Dave mentioned here, I know we had a terrific problem in board manufacture with the improvements in multiwall bags. Certain commodities required a polyethylene liner, some required an asphalt-coated inner liner in those bags. It got to the point where the used bags were very, very objectionable as a secondary material at most mills. It was im-

possible for the wastepaper dealer to open up and tear each individual bag to identify it.

Through the cooperation of the Bag Manufacturers Association they agreed upon their manufacturing label to identify that bag as to what it was, whether it was all kraft free of contaminating materials and so on. From that point on we had the identification. We could then have the bags that were all free that went to a certain type of consumer, bags that had a lesser value because they were asphalt laminated on the inside or had asphalt coated bags on the inside, which were still usable by other mills, but those mills knew what they were getting. They identified their product and they treated it as such when it came in.

Now, it seems to me that we have a variety of identifications here. I think you can start at the top with an item like tabulating cards. I think it would be a simple matter for IBM to identify those cards that they manufacture on a wet strength basis. Put a code number or a signal of some kind on them that is visible to the rather uneducated paper sorter to identify that card. I have no idea how you could identify a wet strength paper, but I just wonder on a lot of these plastic coatings, plastic adhesives, if it isn't possible through a dyeing process, a purple, red or green or orange, for this organization to advocate some such procedure that would identify those things.

Some day 5 years from now or 10 years from now some of you technical men may come up with a solution of the use of this material that is treated with this objectionable adhesive, but I think some program of identification must be developed before you can treat the disease. Beyond that I don't think I can add anything to what Dave said.

Chairman Forsythe: Unfortunately, I don't know whether identification is going to be the complete answer in every case because you can take flying pasters, for example, and you can paint them green very nicely, like this particular sample here, but when you get them in a thick pack of paper and hide them in the center it is an impossible job to sort that one particular thing out. The other problem is this, that in sorting out some of these manila tab cards or materials of that type where they are small and numerous in content, I think it would be extremely difficult to sort them out one by one. It would be practically an impossible job I think.

Mr. Dickson: That is a step in the right direction, if those things must be. Most of these cards would wind up in the same place. After all Navy cards are under suspicion because the Navy does buy a tab card that may have or may not have. Now, if the cards they bought were marked, it wouldn't be too difficult a job to see box after box with the identifying mark.

Mr. Kirkpatrick: They could be tinted.

Mr. Dickson: Once again you have the difficult problem of what is flesh to one is fowl to another. One mill can use these cards and use them to good advantage, and another mill cannot for some reason or another.

Incidentally, that was a good question you asked, how come all this trouble started? I have a good answer to that which I will pass by.

There are some things that can be done along this line, but the principal point I want to bring up is educating these users to the fact that if they use certain things—and once again it is not to hurt anybody, we are all in business, we all have to live, but if they use certain materials in their products, their waste is going to have no value and they might as well know it now. This very question that was brought up that I answered kind of facetiously is becoming more and more important all the time. The converting mills must put out a product that is acceptable and must stand scrutiny, and if they don't have the raw material they cannot make a product that is acceptable to their customers. The sooner we get into this thing and attack it at its very source and make the producer realize—he after all is the person who is going to pay the freight on all of this—the better. I understand that if you pull out this tonnage that the converting mills are making today he is in a spot. We have to start right at the source and educate these people that if they use certain materials their waste is not going to be acceptable as it cannot be converted. What is the test and solution in a problem in one mill is not the solution in another mill. You have to have uncontaminated fibers so that every mill can use them and use them to good advantage, and I don't think it is beyond the impossible.

And to bring my end of the story to a conclusion I have been authorized by the Wastepaper Institute of America—that is a big name for you—I have been authorized by them to offer our full cooperation in anything that you might want to do that is sensible.

Dwight Stocker (Michigan Paper Co.): I am very inclined to agree with Mr. Dickson and Mr. Bergstrom. You can't hit at this at the tail end. You have to start at the beginning. I think the problem of trying to sort it out is impossible. You can't slow up your process that much. There just isn't that much space. You can't have your sorting room that large. Therefore, you have to go to the source and ask the original user to segregate. They do that. They do that in the printing end and the publishing end of our business. They segregate their waste, otherwise they know they can't sell it, and very frankly they watch the prices they are getting for their waste very, very carefully and want to make sure that they sort it so that they get the maximum amount for their waste.

I think that if we attack this problem, we should do it through the identification of our problem, but we also want to do it with publicity afterward telling them what we can use, not by condemnation, but pointing the way where we can give more for waste product which, as Mr. Dickson pointed out, in some cases means quite a margin to them.

Martin Sher (Abbey Corp.): I would like to cite two examples of just what happens when you are on the lookout for this sort of thing. We have two suppliers of wastepaper, both of whom are publishers and they are rather large ones. At one point in our dealing with them we found that we were having all sorts of trouble and it naturally came back to this hot melt adhesive. They called in the adhesive people as a result of our complaint, and immediately we found out what it was, but they couldn't do very much with it and we dropped them as a source of paper.

A little while later I had occasion to visit the second publisher and I said to him that I had run into this experience and that if he contemplated anything of this nature please be good enough to let us know about it. Sure enough, he called me shortly after that and he told me that they were going to try some du Pont material and that he would send us a car of waste which we tried to see how it worked. If it didn't work out he would drop it. But here was a case where by cooperation and by advance notice and warning, which was fortunate, in a sense, because this was a source that was easy to identify, we were able to work this problem out together.

And in line with that, I want to ask Mr. Dickson something in connection with what was said here before. Seven hundred thousand tons of paper are ostensibly used.

Mr. Kirkpatrick: 600,000.

Mr. Sher: Dave, can you give us an estimate of how much of that is easily identifiable in terms of being publisher's waste so that you can go to McCall's, Rumford Press, or the next guy and say it all comes from here?

Mr. Dickson: I would say it is all identifiable, beginning today. If you follow the right procedure. The time to start is now. The past is gone. You have to do the best you can with the past. There are certain publications we know. We have done a job. We have produced all the waste that was necessary for the mills, and no mills have shut down for want of waste that was usable, but the burden has become too heavy and the problem has become insurmountable because you are asking us for uncontaminated paper stock.

Mr. Sher: I would like to know how many tons out of that 600,000 come from the easily identifiable sources.

Mr. Dickson: In any given period I would say you can't identify it because they go on and off. The magazine that is good today and uncontaminated can be contaminated tomorrow and that will follow back three years.

Mr. Sher: That isn't what I was getting at. What I meant was this. If there are 600,000 tons and 200,000 tons are identifiable as coming from McCall's, from Rumford Press, and from someone else, you have an approach to the problem you are talking about here. I ran into a problem with McCall's. Sure, they mark them red, but you couldn't see them anyhow. What I am getting at is, you have got 200,000 out of the 600,000 tons where you can immediately go to these people and say what is confronting you, you have got a third of your problem solved. I am talking about practical means to advance yourselves.

Mr. Dickson: For a lot of reasons I wouldn't want to answer that question. I, of course, know pretty well which are good and which are not, but then you cannot definitely put your finger on it. What we are trying to find is a solution to the problem from here on, and my thought is that the only solution is to make the producer and user conscious of that fact that all of these fibers have to be used again for his own benefit and for his own purse. If he is not made conscious of that then he is in for a squeeze before very many years roll by.

Mr. Kirkpatrick: I would like to ask you one question. You were in the very fortunate and enviable position of identifying a source of bad material a while back and you refused to buy the waste. Didn't somebody else buy the waste and shove it right into the market?

Mr. Dickson: That is always the case. You can't provide against dopes in any business. That is a good way to get rid of them quick.

There is one other thing we haven't talked about. Bill Edwards of the NPA who is in a position in Washington to do a lot of work for us all has assured me that he will spare no effort as far as the Government is concerned within his realm to cooperate with us to every extent with all the facilities of the Government; first of all, from the forestry standpoint, from the conservation standpoint, and from the standpoint of just plain common sense and good business, to further anything that might be done to eliminate these problems you have.

Chairman Forsythe: Thank you, Mr. Dickson. There is one thing I would like to say here. We have kind of kicked this thing around quite a bit. I wonder if there are any publishers present who would have any comments they would like to make. I don't know whether we have any publishers here today or not.

Apparently we don't have any. I think there is a gentleman over there, Harry Young of du Pont.

Mr. Young: It seems to me that the hot melt adhesives manufacturers have been put on a pretty big pan here this afternoon. As one of them I would like to join my competitors, Illinois and National, and say a word about what we are doing. I didn't realize until I came into this meeting how many other things besides hot melt adhesives could contaminate paper. It was said this afternoon that polyvinyl acetate or polyvinyl butylene or synthetic rubber appearing in wastepaper scrap is always a matter of suspicion, and I think it is right that they should be considered suspect materials, but that doesn't mean that they don't represent a good solution to the problem.

You don't have to go away from polyvinyl acetate in order to achieve wastepaper dispersibility, and I think that was supported by Mr. Kirkpatrick in his statement concerning tests with one of our alkaline soluble adhesives, and of the two materials tested at the Robert Gair Co., one was satisfactory and one was not. They were both experimental materials at the time. We are now very busy converting our existing customers over to alkaline soluble hot melt adhesive. This isn't always easy. In some cases we have to make equipment changes on the part of the book binder. They are not too complicated, but it means shutting down equipment for a little while.

In addition we have had our own production problems. We have had to build special equipment in order to make alkaline soluble adhesives that would be acceptable in the customers' plants. We talked about hot melt adhesives being used as magazine cover adhesives and as perfect binding materials. Hot melt adhesives are going into the hard back or edition book field also. It is not there practically at all today, but it is moving in rapidly and before long that will multiply your problem. Hot melt adhesives are here to stay, as we said before this afternoon, and they are here for a very good reason and that is that they let the publisher make better books cheaper and faster. We think, and we think that our competitors feel, that they can solve the problem, and products are available on the market today and are gradually being introduced that will make unnecessary a lot of the research that we think may be planned as a result of this meeting.

Mr. Altieri: I would like to try to correlate two or three of the ideas that have been brought out earlier in the meeting with the idea of possibly adding a little to them. In the first place, one idea is that we must educate the people who make the troublesome raw materials; that is, our friends who make hot melt, lacquers, and the like. That is fine and it is desirable. But, after all, we are having trouble with stuff that was made a year ago and two years ago. And also, without throwing any rocks, you have to have a reason for going to a lot of work, and unless we can show them that it really hurts maybe they will find something else that is more important.

Now, it was also brought out that the large chemical houses will cooperate. I am sure they will. The little fellows who buy 5 gallons of stuff and formulate it and pad books and that sort of thing are much harder to teach. I think possibly that something which will have a bearing on both of these things will start at the other end of the proposition which is you fellows in the deinking plants who have the trouble. When we get a bad lot or when we spot paper which we recognize as being potentially troublesome, we identify it and the cost to us is anywhere between 50 and 300 dollars according to whether we spot it before we spoil a batch or after we spoil a batch or more than one batch. Now, if we are fortunate enough to have a piece of that paper that we can give back to our wastepaper suppliers and say, "Look, this is what ruined us, see what you can do." He in turn, not always but let's say part of the time, may be able either through the printing on it or its qualities know who he bought it from, and wouldn't be long before we could educate a few of the people who are causing the difficulty by bring it right back up the line, and our work wouldn't be in the nature of just identifying a few bad bales but it will help the entire industry through the cooperation of the wastepaper dealers.

Now that brings up another point which I don't think has been touched on much and that is methods of identifying the troublesome material before it ruins two or three tons of wastepaper. I don't suppose to set myself up as an expert on it by any means, but there are rather simple methods by which you can identify some of them, and possibly some of you may be able to suggest some good methods, but what I am getting at principally is, unless we start from the bottom where we are in trouble and through the wastepaper dealers attempt to reach the source of the trouble, which may be a little fellow or a big fellow, it is going to be a long haul because we have a great deal of stuff in the works which is hard to change.

Now finally the question comes up that Mr. Kirkpatrick mentioned. Bill Jones doesn't buy the paper but Joe Smith does. That is all fine for Joe Smith to keep on buying bad wastepaper until it turns out his customers find he is supplying more bad paper than others, and then he naturally will have to try to be a little more religious.

I think perhaps what I mentioned is a little idealistic, but on the other hand it does seem there might be some merit in starting at the bottom as well as at the top in order to make more progress.

Mr. Goodwill: I feel that the thought just expressed is right, that the beginning is at the bottom, and that beginning has already been made. There are more and more mills that are doing this sort of thing. Questionable looking items are subjected to the deinking process in use in that mill and the pulp converted to handsheets. It is true it supplies the answer only so far as this mill is concerned in a good many cases, but in other cases it supplies the answer for all the mills. Certainly the results in any deinking plant are going to be just the same with a sheet like the one shown here, and the same thing applies to this one. (Illustrating samples.) And also with paint chips.

I believe that is a beginning in that more mills are checking their supplies. They are suspicious. The stock is being looked at much more closely through necessity because the market has tightened up. Customers are very, very critical, and I think, as far as Mr. DeFranco is concerned, the answer you asked for a while ago is right here. Up until six months ago there were plenty of customers who would take paper that looked like that (illustrating sample) with a single spot here and there. Today they don't. Therefore, the mill that was using that wastepaper continued to buy it, but now they can't afford it. His customers won't put up with it and he can't take it. It certainly is encouraging to find that we are not—and by we I mean the consumers of the wastepaper, and the suppliers of that wastepaper—far apart at all in our thinking on this. Mr. Dickson said something about our not getting too independent. There is no question about being independent. We all want to live and Mr. Kirkpatrick pointed out in his talk that there isn't any possibility of there being enough pulp to go around to take the place of the wastepaper.

Mr. Dickson: Thanks very much. That is what I wanted to hear.

Mr. Goodwill: It has still got to be used. We know that. But there are certain types that can't be used, and it is a question of how are we going to get over that hump, and I think we are well on the road to doing it. I might suggest this, that something in the way of a permanent representation of the consumers seems to be in order. In the committee that I mentioned in what I had to say this afternoon was after all a temporary affair formed more or less on the spur of the moment. If we are going to cooperate in the best way with the wastepaper dealers, I think that something in the way of a permanent organization representing the consumers is indicated, and perhaps there should be some sort of an expression on that.

Larry Brown (St. Regis): I would like to make a suggestion for what it is worth. Why doesn't the National TAPPI more or less toss the ball into the laps of the various local sections. In each one of these local sections we have any number of mills that are interested in this problem. Why don't we appoint interested parties to meet with the wastepaper dealers, the adhesive manufacturers, and the publishers in that immediate area just as an educational program and kind of point out what all the mutual problems are? In that way we will cover the whole country doing it through the local sections.

Chairman Forsythe: I would like to make one comment on that idea. I think that some of that work is already being undertaken now. At Fitchburg on March 21 the New England TAPPI Section is sponsoring a meeting on deinking. I know that our Empire State Section of TAPPI in June of this year is sponsoring a meeting on deinking, and there are quite possibly a number of other sections that may have that idea.

However, at the same time, speaking merely as an individual, I wonder if this is a problem that TAPPI is organized to do or should sponsor. It should serve as a medium possibly for bringing you different people together. There are certain ramifications, though, I think, that go beyond technical aspects which might make advisable an entirely separate organization. I would like to hear some other expressions of opinion on that matter.

Mr. Kirkpatrick: I think you are right about that. I think the thing is much broader than anything that TAPPI can handle right now. TAPPI can do a fine job. On the other hand, I feel that this is a problem concerning top management in the deinking mills and the Wastepaper Dealers Association itself. I think it is not for the technical men in the mills to handle alone because it is much too broad. It is really life or death for those of us who do deinking and bleaching and trying to make a fiber for white papers. I think perhaps the basis on which we started to work in Kalamazoo, if projected on a national scale, might be the basis for some really fundamental work on it.

An association of the deinking mills to cooperate with Mr. Dickson's group is what is needed, and I am sure that will have to be outside the realm of TAPPI.

Chairman Forsythe: Are there any other opinions? I wonder if somebody would make a concrete suggestion on how to handle this matter. Whether we should set up, or try to set up, since we have so many mills represented here today a committee to act temporarily as a clearinghouse, and as a group to get together with wastepaper dealers?

Mr. Kirkpatrick: I make the suggestion that Fred Goodwill be selected as a chairman who will select a group of men outside of TAPPI who will work with Mr. Dickson's group. I make that in the form of a motion, and perhaps we can get the thing on some sort of a semiofficial basis outside of TAPPI.

The motion was duly seconded by several members.

Chairman Forsythe: Thank you.

Mr. Goodwill: I am willing to go along.

Mr. Kirkpatrick: It is very important to all of us and I am sure whoever he selects to help him will do a good job.

Mr. Goodwill: Might I suggest this, that anyone feeling so inclined send in an expression of his ideas to me and I would like to keep Bill Kirkpatrick and Jim Wise right along with me for now.

Mr. Kirkpatrick: The chairman does all the work anyhow.

Mr. Goodwill: Send in your expressions to furnish some sort of a guide as to what the thinking is. It is a very serious matter, and for that reason I am certainly, for one, willing to do everything I can to keep this ball rolling now that it has gotten started and gained good momentum. But we will need a lot of help and I don't think there is any question whatever after this afternoon's session that we will have it coming to us.

Chairman Forsythe: Are there any other comments? Perhaps it would be well if I asked the wastepaper dealers how they feel about this idea, and if they want to go along with this suggestion.

Mr. Dickson: We are not only willing but, of course, we are very anxious to go along with it. We know that we have an interest in common, and anything that could further our interests we would go along with and will proceed to the end.

Chairman Forsythe: Thank you, Mr. Dickson. Are there any other comments or business you would like to bring before this meeting?

Mr. Hynes: I have a feeling that since latex is an objectionable material that mills are contributing to it themselves because they are the biggest users. I am not prepared to say what particular latex we are using. I have forgotten the brand number, but we are using latex very successfully and we don't even deink it. We don't feel that it is objectionable. Is there a man here who could answer what type of latex seems to be objectionable?

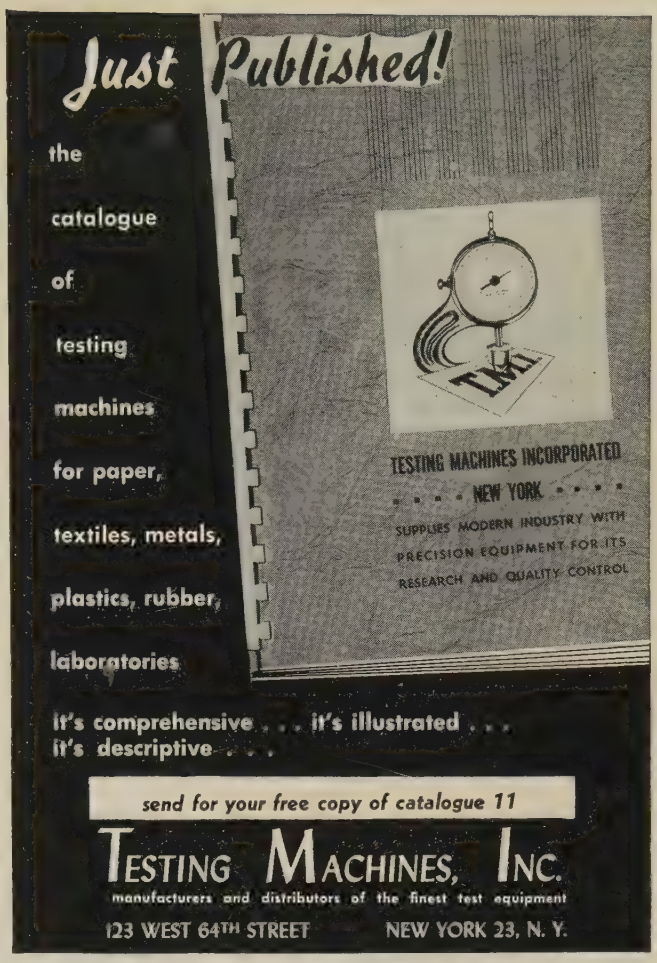
Mr. Doughty (Fitchburg Paper Co.): I have heard from a couple of people here this afternoon—you, Ronnie, and one or two others—who have said that their experience with deinking their own paper in which latex was used in the binder has been

entirely successful. I am not a latex producer, nor do I use it. I have talked in the last few weeks to a number of people, U. S. Rubber and some of the outfits down around Boston, who make or convert latex. They are all very interested in this problem when we tell them we are having trouble with rubber and something of that sort in paper—they are extremely interested right off the bat, and the first thing they ask is, doesn't this latex that is used so extensively in paper binder, adhesive binders, and coating operations cause you a lot of trouble? Up to the present time I have been able to tell them definitely just that we haven't proved it yet. Apparently a lot of other people are convinced of the same thing that use of latex is not the potential source of trouble at the present time. Just as soon as I tell them they lose considerable interest in the problem. I know in our case we caught hell for a while. About 97 or 98% of it was due to these flying pasters which we found with considerable assistance from Jim Forsythe. Since we have eliminated that source of trouble we are at least in the position where we live with the thing and try to work on some of the refinements of cleaning up the paper. But as far as any use of latex is concerned, as I said, the producers of latex seem to feel that the only big use of latex in the paper field is as a coating binder, and as soon as they find out that it is apparently perfectly safe they are not very much interested in going along any further. I hope there is someone here this afternoon who hears that.

MR. BRADBURY: I might say we can say definitely we have used a lot of paper that has had a lot of rubber latex in the coating and as far as latex coatings are concerned we have had no difficulty at all.

CHAIRMAN FORSYTHE: We have tried 512-K and we have not had any difficulty in the concentrations we have encountered.

If there is no further business to bring before this meeting, I will call this meeting closed.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CLINTON FOODS INC.
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Fiber Orientation in Paper (Zero-Span Tensile Strength)*

TAPPI Suggested Method T 481 sm-52

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE PAPER TESTING COMMITTEE)

This method provides a means of measuring the orientation of fibers in a sheet of paper. It is superior for this purpose to the normal tensile strength test because the latter is influenced by the way the fibers are felted in the sheet, their stretch and that of the sheet, the bonding between the fibers, and other factors that have less influence on the zero-span tensile test.

Hoffmann Jacobsen (*1*) found that the average zero-span tensile strength of a laboratory-made sheet from cotton fibers with random orientation was one half that obtained when the fibers were arranged and gripped parallel to the gripping attachment. This ratio may vary with different fibers, but the direction in which the parallelism of the fibers is greatest will always give the maximum zero-span test. Consequently, if a line be drawn across a sheet of paper and test strips be cut at various angles to this line, the variation in the zero-span tensile strength of these strips will give an indication of the orientation of the fibers in the sheet. For example, if the fibers have completely random orientation, all the test strips will give essentially the same result.

APPARATUS

1. A tensile tester in accordance with TAPPI Standard T 404 m having a range of at least 20 kg. (or 45 pounds).

2. A Clark zero-span jaw attachment as shown in Fig. 1. This shall comprise two pairs of jaws, *AB* and *CD*, made from hard-tempered tool steel. One pair of jaws, *CD*, is fixed to plate *E* and the other pair, *AB*, slides in this plate and may be clamped to it by means of the knurled screw, *F*. Tangs are provided at the ends of the pairs of jaws to permit the attachment to be clamped in the stressing jaws of the tensile tester. The outer jaws *B* and *D* shall be movable and arranged so that they can be closed against the inner jaws *A* and *C* by means of the screws *G* and *H* and springs *J* and *K* with a fixed pressure which, however, is variable by adjusting the thicknesses of the washers *L* and *M*. When the screws *G* and *H* are loosened, jaws *AB* and *CD* are caused to open by springs located in the jaws at *N* and *O*, to a distance controlled by the screws *P* and *Q*. Jaws *B* and *D* pivot on spherical or conical seatings *R* and *S*. The angle of contact between the pairs of jaws *AB* and *CD* is increased by screwing in the screws *T* and *T'* and is normally set about 1°, so as to increase the applied pressure at the tips of the jaws.

Figure 2 shows an enlarged view of the tips of the jaws *AB* and *CD*. *VU* is the tip of the jaw *A*, *WU* is the tip of jaw *B*, and *YU* and *XU* are the tips of jaws *C* and *D*. *ZZ'* is the plane of the clamping surfaces. The jaws are preferably cut with an angle of about 40° between faces *VU* and *YU* and between *WU* and *XU*. When tightened in position, the gripping edges *U* of the four jaws *A*, *B*, *C*, and *D* shall lie in the plane *ZZ'* to within 0.0001 inch. The gripping faces of the four jaws shall be provided with three or four grooves as shown, but the distance from the edge of each groove nearest the common contact line *U* shall not be less than 0.04 inch (1 mm.).

The width of the jaws *AB* and *CD* shall be 15 ± 0.05 mm. (0.592 ± 0.002 inch) and their outer surface (sides) shall be in alignment to within the same tolerance.

The thickness of the tangs at the ends of the jaws shall not exceed 0.05 inch (1.2 mm.) and the distance between them shall be such that they fit into the jaws of the tensile tester when its jaws are about 180 mm. apart.

Note: Because of the close tolerances necessary, any rusting of the tips of the jaws may impair the accuracy of the test. When not in use the attachment should be oiled with a light, noncorrosive machine oil and kept in a desiccator or a quart Mason jar containing a quantity of anhydrous silica gel.

CALIBRATION

Loosen screw *F* a quarter turn and slide jaws *AB* in plate *E*. Check that friction is absent and also that there is no lateral looseness of the jaws in the slide.

Press the tips of the jaws *AB* and *CD* together and tighten the clamping screw *F*. Tighten screws *G* and *H* and place the assembly under a microscope with a magnification of 50× or greater. Check that the edges of the four jaws *A*, *B*, *C*, and *D* meet at a point *U* (Fig. 2) within the given tolerances on both sides of the assembly. Loosen screws *G* and *H* and adjust screws *P* and *Q* so that the tips of jaws *AB* and *CD* open apart from 1 to 1.5 mm. (about $^1/_{16}$ inch). Insert a strip of thin paper between the jaws *AB* and *CD* and tighten screws *G* and *H* until they just meet their stops.

* This method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 122 E. 42nd St., New York, N. Y.

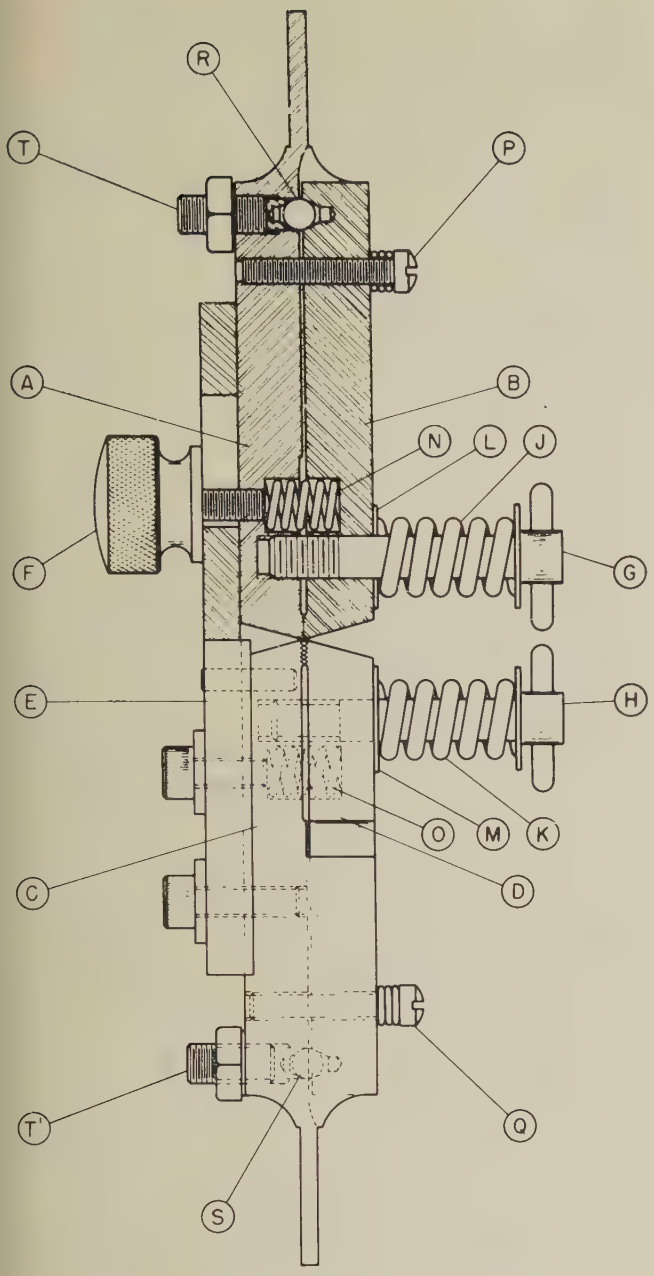

Fig. 1. Zero-span jaw attachment

Loosen these screws, remove the strip of paper and, with a hand lens, examine the imprint of the jaws. See that there is no discernible ridge in the paper corresponding to the line *U* in Fig. 2 and that the compression-strip marks under the tips of the jaws are uniform in appearance. When screws *G* and *H* are tightened to their stops, they should exert approximately equal pressures and sufficient to hold or break one or more thicknesses of paper at upwards of a 40-pound pull without slippage.

Clamp the attachment in the tensile tester and, carefully following the test procedure as later described, obtain an average reading on five strips of a good quality of kraft wrapping paper.

Retest the same sample with an extra $^1/_4$-inch diameter standard washer added to *L* and to *M* so as to increase the effective clamping pressures, and note if the average test is now significantly higher or lower. If higher, add a second washer to each and again carry out the test, and repeat until the test results show a decrease, or at least no increase. If all the compression of the springs is taken up with the added washers and the test results continue to increase, the springs should be replaced with stronger ones. Normally a spring with five turns of 0.10-inch diameter steel wire will be found suitable. If the added washers cause a decrease in the test results, this is an indication that the optimum clamping pressure has been exceeded and the added washers should be removed.

Note: The effective clamping pressure may be increased for special purposes by increasing the clamping angle between the pairs of jaws by adjusting the height of the pivot points *R* and *S* by means of screws *T* and *T'*. However, this may disturb the coincidence of the tips of the jaws. In general, it has been found that the optimum closing pressure required is not very critical, provided that the tips of the jaws are coincidental.

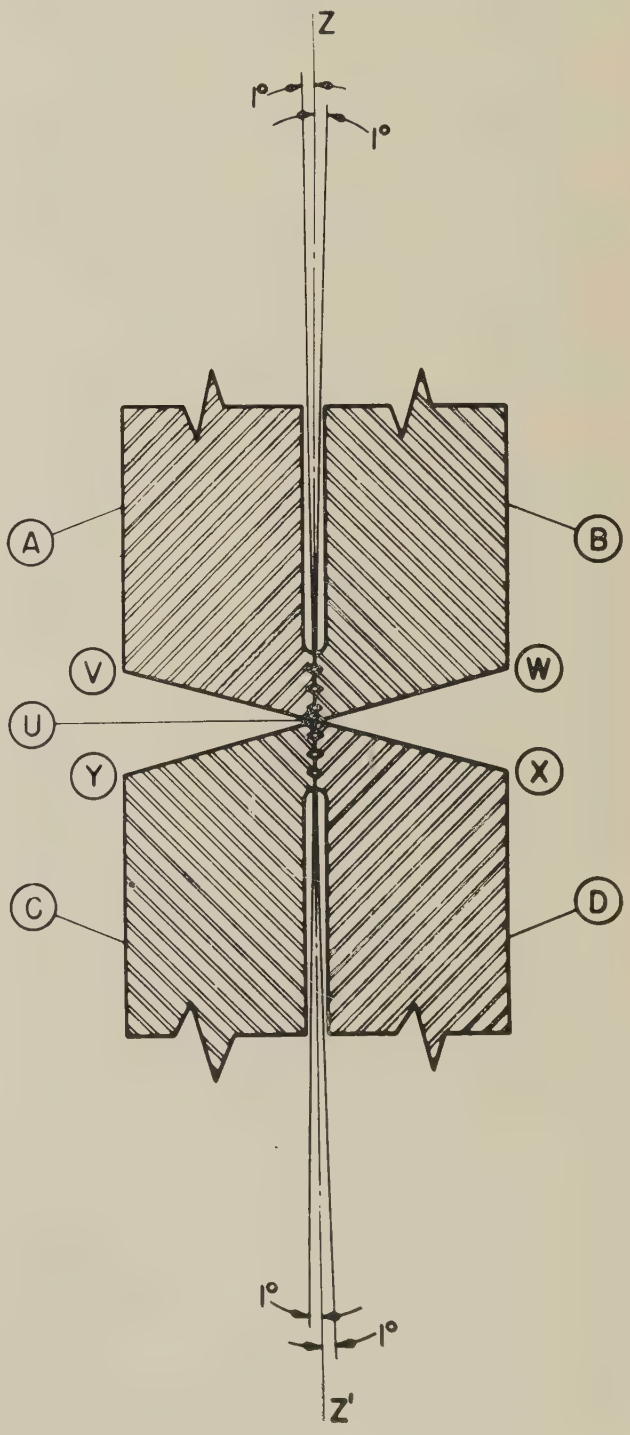

Fig. 2. Jaw tips

Disconnect the upper jaws *AB* and clamping screw *F* from the attachment and weigh and record the combined weight to the nearest 0.05 kg. (0.1 pound).

TEST SPECIMEN

The specimens for test shall consist of strips cut from the sample between 6 mm. ($^1/_4$ inch) and 18 mm. ($^3/_4$ inch) wide and of any convenient length over 15 mm. ($^5/_8$ inch). The strips shall be cut as follows:

If the principal directions of the sheet are known, draw a line near the center of the sheet parallel to the machine direction. Cut one strip parallel to this line. Then cut strips at angles of 15, 30, 45, 60, 75, and 90°, respectively, from the reference line. (The last strip will be cut in the cross direction of the sheet.)

If the directions of the sheet are not known, draw a line near one edge of the sheet. Cut one strip parallel

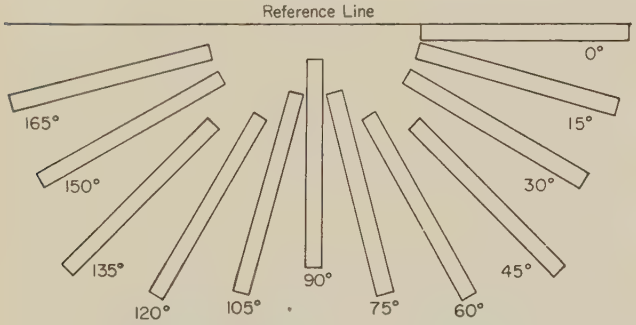

Fig. 3. Location of test strips

to this line and then eleven more strips at intervals of 15°. (*See* Fig. 3.)

Note: The exact dimension of the fracture in the specimens is controlled by the width of the jaws (15 mm.) so that, provided the area of each specimen is such as to enable it to be securely clamped across the entire line of fracture the actual size of the specimen is immaterial because the portion, if any, protruding from the sides of the jaws will not affect the results.

If the results are desired for future comparison, the test specimens should be conditioned and the test made in an atmosphere conditioned in accordance with TAPPI Standard T 402 m; otherwise this is not necessary.

PROCEDURE

Loosen the clamping screws *G* and *H* until the jaws are fully open (about 1 to 1.5 mm.). Loosen the knurled screw *F* slightly, press the tips of the jaws firmly together and, while still under pressure, tighten the screw. This is conveniently done by pressing the tip of one of the tangs of the attachment against the top of a bench or the body with one hand on the other tang and tightening the screw *F* with the fingers of the other hand.

Insert one end of the test strip between the opened jaws so that it projects beyond the other side and adjust its position so that the strip is located beneath the serrated clamping surfaces and at right angles to the jaws. Tighten one of the screws *G* or *H* finger-tight to hold the strip in position. With the key provided, tighten the other screw all the way in until it just meets its stop; then with the key similarly tighten the other screw.

Lock the pendulum of the tensile tester at zero and set its jaws about 180 mm. apart. Place the attachment with the specimen centrally in the jaws of the tensile tester and clamp firmly in position.

Note: Should the jaws of the tensile tester be for a specimen width other than 15 mm., it is desirable if they are wider to attach a stop on the jaws to center the tangs automatically, or if they are narrower, it will be necessary to reduce the width of the tangs to suit. In any case, the attachment must be clamped so that its center line coincides with the center line of the jaws of the tensile tester.

Loosen clamping screw *F* a quarter turn, unlock the upper jaw of the tensile tester, unlock its pendulum, and apply a load at a rate in accordance with TAPPI Standard T 404 m. Keep one hand on the stop lever of the tensile tester, and when the specimen breaks, *immediately* stop the stressing jaw of the tensile tester; otherwise, with the construction of the attachment, if the stressing jaw moves $^1/_4$ inch further, the pendulum will be further loaded and the indicated reading lost.

Caution: Be careful not to pull the stop lever into reverse at this point otherwise the attachment may jam between the jaws of the tensile tester and cause serious damage to the latter.

Record the indicated breaking load to the nearest 0.1 kg. (0.2 pound) and remove the attachment from the tensile tester. Now reverse the stressing jaw of the tensile tester to return it to its starting position. Loosen the clamping screws *G* and *H* of the attachment and remove the broken specimen or pull the specimen strip along to a new place beyond the fracture. Press and clamp the zero-span jaws together and proceed as before to make the next test. Make at least five individual tests on each strip, discarding any individual results which are 10% or more below the average of the others as such results are probably caused by a hidden defect of the sheet.

From each result subtract the weight of the upper jaws and knurled screw *F* to give the zero-span breaking load.

REPORT

When the machine direction of the sheet is known, report the average zero-span tensile strength in the machine direction, the cross direction, and at intervals of 15° between. Otherwise, report the average zero-span tensile strength from 0 to 165° on strips cut at 15° intervals from the reference line on the sheet.

State in the report whether or not the tests were made on a conditioned or unconditioned sample.

ADDITIONAL INFORMATION

1. The zero-span test has good reproducibility, probably within 5% if care is taken with an accurate finish and calibration of the attachments. The highest skill and care are required in making them so that, unless exceptional facilities and workmanship are available, attempts to produce a "homemade" attachment will probably result in disappointment.

2. For accuracy, it is not advisable to test sheets having a thickness of much less than 0.002 inch because thin sheets magnify the effects of inaccuracies of the jaws. For such sheets, test two or more together, but use a minimum-number per test, as a combined thickness of more than 0.005 inch may cause somewhat low results.

3. If desired, tests may be made on strips cut at intervals of 10° instead of 15° from the perpendicular.

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Clark, James d'A., "The Ultimate Strength of Pulp Fibers and the Zero-Span Tensile Test," *Paper Trade J.* 118, No. 1: 29–34 (Jan. 6, 1944); *Tech. Assoc. Papers* 26: 285–90 (1943).

Ink-Erasing Quality of Paper*

Revision of TAPPI Suggested Method T 478 sm-50

(THIS SUGGESTED METHOD IS UNDER THE JURISDICTION OF THE PAPER TESTING COMMITTEE)

THIS method is based on the controlled abrading procedure of Codwise (*1*) and Lafontaine and employs the rubbing action of an abrasive cloth applied under standardized conditions in a mechanical abrading apparatus. It is applicable to various types of paper surfaces and although the method covers the erasure of standardized writing-ink markings, the principle described can be employed to advantage for all types of erasure work.

DEFINITION

Erasing quality is defined for the purpose of this test as the difficulty of erasure with a mechanical abrading apparatus of standardized marks made with standard writing ink on the surface of the paper in question. The apparatus employs the rubbing action of No. 180 silicon carbide cloth. The difficulty of erasure is measured numerically, and observations are made of the resistance to fuzzing of the surface of the paper as well as for the writing qualities of the erased surface.

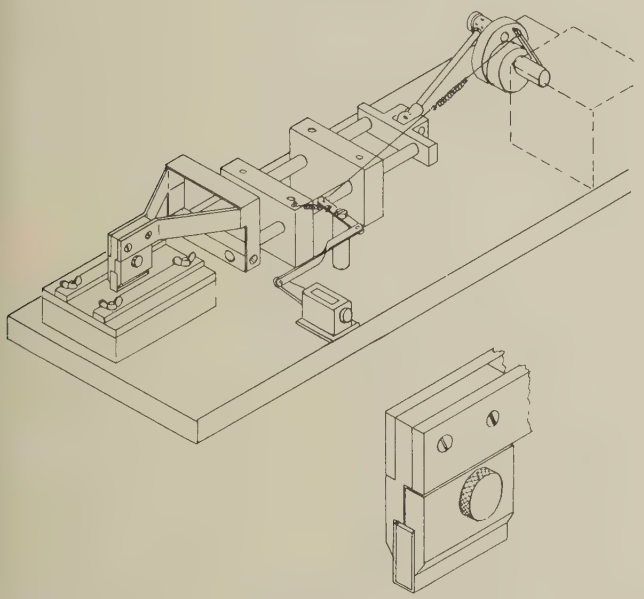

Fig. 1. Abrading machine and detail of eraser attachment

APPARATUS

1. *Abrading Machine.* This shall be of the general type shown in Fig. 1 and shall comprise the following essential features:

(a) A movable abrading head assembly having an effective weight of 330 grams. It is necessary that this have a carefully controlled abrading action and that the weight of 330 grams be exerted during the entire stroke of the head.

(b) Means for moving the abrading head across the surface of the specimen at a rate of 120 single 2-inch strokes per minute, and a counter for recording the number of strokes.

(c) Provision in the abrading head to accommodate an abrading medium 1 inch long and $^3/_8$ inch wide, and to hold it firmly in place.

(d) Provision for clamping the paper specimen on a metal plate 5 inches in diameter, covered by a stable rubber apron cloth as specified below in item 5.

2. *Ruling Pen.* A ruling pen of standard quality with adjustment capable of giving an opening between the nibs of 0.001 inch. (The opening may be checked by means of a 0.001-inch thick sheet of material such as aluminum foil.)

Note: The pen described by Schur and Levy, *Tech. Assoc. Papers* 29: 160 (1946), is particularly suitable.

3. *Abrading Medium.* A firm, hard-grained cloth. No. 180 silicon carbide cloth of the Carborundum Co., Niagara Falls, N. Y., has been selected as standard.

4. *Rubber Packing for Abrasive Cloth.* A solid section of soft rubber $1^3/_8$ by $^5/_8$ by $^{11}/_{32}$ inches, having a Durometer test (ASTM Method D 676–44T) of 45 to 50. A Faber No. 112 eraser is suitable.

5. *Rubber Bed for Supporting Specimen.* A rubber apron cloth $2^1/_4$ by $3^1/_4$ inches, and $^1/_{16}$ inch thick, having a Durometer test of 90 to 95.

6. *Micrometer.* A thickness micrometer with ball-pointed spindle.

REAGENT

Standard Ink. The ink used for this test is in accordance with the following formula, and is the same as that used in T 431 m.

* This method is suggested by the Standards Committee as being the most suitable to date. It is *not*, however, a TAPPI Standard. Criticisms are earnestly requested and should be sent to R. G. Macdonald, Secretary, Technical Association of the Pulp and Paper Industry, 122 E. 42nd St., New York 17, N. Y.

	Grams
Tannic acid	11.7
Gallic acid crystals	3.8
Ferrous sulphate	15.0
Hydrochloric acid, U.S.P. dilute (2.72 *N*)	12.5
Carbolic acid (phenol)	1.0
Soluble blue (Schultz No. 539, C.I. 707)	3.5
Distilled water to make a volume of 1000 ml. at 20°C. (68°F.)	

All chemicals shall be of C.P. quality. The dye specified should be used because some blue dyes react with carbolic acid to cause a film having a metallic appearance. The ink is made as follows: Dissolve the tannic acid and gallic acid in about 400 ml. of water at about 50°C. (122°F.). In a separate vessel, dissolve the ferrous sulphate in about 200 ml. of water which contains the HCl. In a third vessel dissolve the dye in about 200 ml. of water. Mix the three solutions in a 1-liter volumetric flask, rinse the vessels with small portions of water, and add the rinsings to the flask. Add the carbolic acid and dilute with water to 1 liter at 20°C. (68°F.).

TEST SPECIMEN

The test specimens shall be cut from samples selected as prescribed in TAPPI Standard T 400 m. At least 20 specimens are required, each $2^3/_4 \pm {}^1/_{16}$ inches square, with machine direction and wire side marked.

CONDITIONING

The specimens shall be conditioned, before testing, in accordance with TAPPI Standard T 402 m, and tests shall be made in the atmospheric conditions therein specified.

PROCEDURE

Cut a piece of the silicon carbide cloth $1^1/_2$ by 1 inches, with the grain the short dimension, and fold it parallel to the grain around one of the longer narrow edges of the $1^3/_8$ by $^5/_8$ by $^{11}/_{32}$-inch rubber backing. Fit this combination into the erasure head with the abrasive cloth surface exposed, taking care not to crack the abrasive face.

Determine accurately the average thickness of the specimen over the area to be abraded. Using the standard ink, draw upon it, in the direction in which it is to be abraded, a line 1 inch long with $^3/_{16}$-inch long cross hatchings spaced about $^1/_8$ inch apart. Hold the drawing pen, set at an opening of 0.001 inch, in a position perpendicular to the surface, and use just enough pressure to draw a continuous line. The nibs of the pen shall not be sharp enough to cut the surface of the specimen.

The success of the test depends upon the proper contact of the paper with the abrasive medium during the erasing process. To ensure this, lower the erasure head with the abrasive cloth and backing loosely in place upon the rubber bed prior to inserting the specimen, adjust the position of the erasure head firmly in place without downward pressure, and then tighten the screw so as to hold the lower surface of the erasure head uniformly in contact with the bed.

Allow the ink marks on the specimen to dry thoroughly (for at least 5 minutes), then place and center the design upon the rubber apron cloth of the abrading machine, being sure that both the rubber apron cloth and specimen are carefully smoothed out. Lower the erasure head upon the specimen and firmly tighten the screws of the paper clamps to hold the specimen in place. Set the counter at zero, start the motor, and determine the number of single strokes of the head required to completely erase the design. During erasure, note the behavior of the surface, especially its tendency to fuzz.

Upon completion of the first erasure of the lines, including the center line and the cross hatchings, to a distance of at least $^1/_{16}$ inch on either side, remove the specimen from the machine and carefully examine it; then measure the average thickness. If desired, redraw lines upon the erased part of the specimen as before, and in the same place, and note the difference in writing characteristics with special attention to the tendency of the lines to feather. Remove the abrasive cloth from the machine, discard it, insert a new piece, and reset the head and the counter. Perform a second erasure in the same manner as the first one, making the same observations. Repeat the process, except for the thickness measurement, until the specimen has been rubbed through.

Make at least five complete tests from each side of the paper and with and across the grain.

REPORT

The complete report shall include, for each side and direction of the paper: (1) *Erasure Number* (the aver age number of strokes) for each erasure; (2) average thickness of sheet removed in the first erasure; (3) tendency of the sheet to fuzz; (4) writing characteristics of the erased surface; (5) if desired, the *Total Erasure Number*, which is the average number of strokes required for all the erasures in both directions and on both sides of the paper.

ADDITIONAL INFORMATION

The special type of instrument which has been designed for this test, shown in Fig. 1, simulates the rolling and rubbing action of the erasure procedure. Rotary types of abrading machines are not suitable because the rolling and scuffing action is absent.

Usually it is not necessary to continue the test until the paper is completely worn through; the Erasure Number for the first erasure and observations on the conditions of the erased portion of the sheet and on its writing quality after erasure are generally sufficient.

The Total Erasure Number is a measure of the overall ability of the paper to withstand abrasure and of the penetration of the ink.

The revision of this method adopted in 1952 differs from the previous method in the apparatus used and in the introduction of the term Erasure Number.

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Instrumentation Studies. LXX. A Study of Instruments for the Measurement of Opacity of Paper

III. *The Weston Opacity Meter and the Welch Densichron*

L. R. DEARTH, O. H. OLSON and J. A. VAN DEN AKKER

For the purposes of accurate research and the needs of commercial specifications, the opacity of paper should be measured and expressed as a contrast ratio. However, where one has established a correlation between light transmission and contrast ratio for the papers in production, a light transmission instrument has the advantage of speed and may prove to be satisfactory for the mill control of opacity. The present observational study was undertaken to test this possibility, using a Weston opacity meter and a Welch Densichron. The former expresses opacity as $(1 - T)$, whereas the latter measures T, where T is the transmission of the paper. The instruments are described, and the conditions for stable operation are discussed. In order that the suitability of the instruments for the mill control of opacity might be judged, measurements of TAPPI opacity and printing opacity (both contrast ratios) were made with a standardized Bausch and Lomb opacimeter, and observations of Weston $(1 - T)$ and Densichron T were taken for each of a series of 38 papers differing widely in basis weight, thickness, and type. The data obtained with the latter two instruments were plotted against TAPPI opacity and printing opacity. The charts thus obtained show generally good correlation but the deviations for individual papers may, in certain instances, be rather large. The data indicate, however, that a stable transmission instrument should be effective for the mill control of opacity if its calibration for the papers in actual production is checked against a standard opacimeter at reasonably frequent intervals.

CONTRAST ratio in the form of TAPPI opacity or printing opacity has long been advocated for the measurement of the opacity of paper. The reader interested in the scientific and technical reasons for this advocacy is referred to Part I of this report (*1*); there he will also find references to all the important literature on this subject prior to, and including, 1937. Studies reported elsewhere since 1937 have elaborated certain technical aspects and have bolstered the opinion that, for the purposes of accurate research and also for the needs of commercial specifications, TAPPI opacity and/or printing opacity should be employed.

In particular, the use of light transmission for these purposes has been, and is now, considered to be objectionable. The disadvantages of opacity measures based on light transmission are presented in Sections I and IV of Part I of this report (*1*). Only a single major advantage exists in a limited but important use: Where one has established the correlation between contrast ratio and transmission for the particular grade of paper in production, the measurement of transmission affords a quick and simple means for the mill control of the opacity of the paper. The correlation is maintained by reasonably frequent checks against a standard opacimeter, and the transmission limits for satisfactory operation are thereby adjusted. If it be understood that such correlation is maintained, then it may be said that speed of measurement is the most important factor in the mill control of opacity. Only a single reading is needed for each tested spot in a sheet, and one can make that reading in almost as little time as is required to caliper a sheet with a dial micrometer thickness gage.

It was with the foregoing thoughts in mind that the present observational study was made of the new Weston opacity meter* and the Densichron.† No attempt has been made to study these instruments from a fundamental point of view, because it is obvious from their design that they could not yield measures of transmission which would be functionally related to the fundamental optical properties of paper. Rather, measurements have been made which should enable one to forecast the success of these instruments when used for the mill control of the opacity of paper. Measurements with the two instruments were combined in a single project so that time could be saved.

THE WESTON OPACITY METER, MODEL 977

Opacity, as determined with this instrument, is taken equal to $(1 - T)$; accordingly, the reading for a perfectly opaque sheet is 1.0 or 100%, and the reading with no sheet in the instrument is zero.

The instrument (Fig. 1) is small, being comprised of a metal case 8 by 12 by 4 inches high, which encloses a light source, a simple optical system, an electrical meter, and the necessary rheostats and wiring. The meter face, controls, and switches are located on the top panel of the instrument for ease of reading and manipulation.

The optical system gathers light from a 50-watt, 110-volt concentrated filament lamp and directs it upon the bottom side of a $^5/_8$-inch disk of opal glass mounted in the top panel of the instrument. As shown in the photograph (Fig. 1), a Weston Photronic cell is hinge-mounted in a housing fitted with a conical member that is designed to exclude all extraneous light when the photocell is manually held down upon a specimen, which, of course, is located between the

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* Weston Electrical Instrument Co.
† W. M. Welch Manufacturing Co.

illuminated opal glass and the photocell. The photocell of the particular instrument studied was not equipped with a "Viscor" filter; this filter renders the relative spectral response of the combination of filter and photocell similar to that of the human eye. However, the substitution of a photocell with such a filter was easily

Fig. 1. The Weston opacity meter

made, and most of the data later reported for the Weston instrument were obtained with this filter; some measurements made with the instrument as received were obtained for comparative purposes. As received, the instrument did not contain a voltage regulator, although it is the intention of the manufacturer to place a regulator inside the instrument case when the instrument is manufactured as a regular production item. In the present work, the instrument was operated with a voltage regulator from our laboratory and on lines of automatically controlled frequency; sudden excursions of the frequency of these lines from 60 cycles per second are rarely more than a small fraction of 1 cycle per second. This nearly ideal condition does not exist in a number of mills, where only the average frequency is nearly constant, and the voltage output of regulators of the ordinary type will be unsteady because of sudden fluctuations in the frequency of the power line (*2*).

In use, the instrument is first adjusted to zero (100% transmission) by lowering the photocell upon the illuminated opal glass and adjusting the rheostat which controls the current through the lamp. The specimen is then inserted, and $(1 - T)$ is read directly from the scale.

THE WELCH DENSICHRON

The Densichron derives its name from its most typical use as an instrument for measuring the density of photographic emulsions. We have recently given a brief description of its principle of operation in Report No. 17, Part IX (*3*); the principle of the "Magnephot" has been set forth by Kalmus and Striker (*4*). A photograph of the instrument, equipped with a linear electrical meter, is presented in Fig. 2. When used with an illuminated diffuser of light, such as an illuminated disk of opal glass, this instrument may also be used to measure the transmission of a paper sheet. The instrument may be obtained with either a linear or logarithmic meter (the latter designed to yield density—i.e., $\log_{10}(1/T)$) and, in the latter case, it is possible to employ an auxiliary linear meter which may be plugged into the side of the instrument case. The probe, which contains the phototube, is placed upon the illuminated diffuser and the instrument is adjusted to read 100% transmission; the specimen is then inserted between the diffuser and the probe and the transmission (T) is read.

The most unusual operating factor of the Densichron is the very high sensitivity of the instrument, which results in great versatility of application. For example, inexpensive equipment not requiring lenses or other optical parts may be used for measuring transmission or reflectance (*3*). In the present work, diffuse illumination for transmission measurements was obtained by simply making a 6-inch cubical box (painted flat black inside) which was furnished with a $^3/_4$-inch hole in the top surface containing a disk of opal glass; this was illuminated with a 32-cp. automobile lamp; one side was left open for cooling. The lamp was located 3.5 inches directly below the opal glass with its axis horizontal and the V of the filament in a horizontal plane. The probe was hinge-mounted on top of the box so that the phototube aperture met the opal glass disk concentrically when lowered.

In the interest of maintaining constant color temperature of the lamp, the lamp voltage was held constant and adjustments were made with the sensitivity controls of the Densichron. At the time of the work, it was not yet known that the linearity error of the Densichron depends upon the sensitivity setting (*3*). However, a later inspection of the experimental runs showed that the operating conditions were so steady that the variations in the linearity error were not of consequence. It is important to note that such condi-

Fig. 2. The Welch Densichron

tions will not generally exist and that the linearity error varies from one Densichron to another (*3*). Accordingly, a mill calibration for one instrument may not be employed for another. Until this condition is remedied by the manufacturer, one should set the controls of the Densichron at appropriate *fixed* values,

and make adjustments through a variation of the light intensity, preferably in a manner designed to maintain constant color temperature.

A Densichron in normal adjustment yields a steady deflection for constant illumination in spite of small changes in line voltage or frequency. Early in our first work with the Densichron, fluctuations were observed when the line voltage was almost perfectly steady. A variable frequency alternator was then employed to study the frequency dependence of the instrumental response for constant line voltage. The data showed that the response-frequency curve exhibited a maximum and was nearly symmetrical (resembling a typical resonance curve). In the case of the instrument studied, the maximum centered on 58.8 cycles per second, and the slope of the curve at 60 cycles per second was sufficiently great that very slight variations in the frequency of the line caused noticeable and bothersome fluctuations in the deflection. A circuit component was then suitably modified, and the maximum in the response-frequency curve was shifted to a frequency between 60.0 and 60.1 cycles per second. The maximum in the curve is sufficiently broad that fluctuations have since been inappreciable.

The Densichron (like the Weston opacity meter equipped with a voltage regulator) should be operated on lines of accurately controlled frequency, with particular regard to the absence of sudden changes in frequency.

Table I. Description of the Papers Used in the Study

Designation of paper	*Basic weight (25 × 40—500), lb.*	*Thickness, 0.1 mil*	*Description*
A	29.9	24	Bleached glassine
B	31.1	22	Unbleached glassine
C	50.3	43	100% bleached sulphite handsheet
D	46.0	41	100% bleached sulphite handsheet (yellow)
E	38.0	36	75 to 80% groundwood
F	54.5	47	100% rag paper
G	38.0	40	Newsprint
H	42.0	22	Waxed bread wrap
I	29.9	20	Unwaxed bread wrap
J_1	17.8	16	Onion skin
J_2	25.4	21	Onion skin
K	28.4	22	Unwaxed bread wrap
L	74.0	35	Coated, supercalendered
M	5.1	12	Cigarette paper
N	43.3	40	Groundwood book paper
P	60.5	55	Unbleached kraft
R	47.9	44	60% bleached kraft, 40% bleached sulphite, TiO_2
S	42.2	44	Book paper
T	53.2	40	Bond paper
V	66.0	48	Ledger paper
W	62.5	32	Coated, brush finish enamel
X	48.1	35	Coating raw stock
Y	45.0	41	100% bleached sulphite handsheet (red)
Z	61.8	68	Filter paper
1	31.8	30	Catalog paper
2	29.2	27	Catalog paper
3	42.5	24	Catalog paper
4	38.8	28	Catalog paper
5	27.3	19	Catalog paper
6	41.5	32	Catalog paper
7	37.4	29	Bleached sulphite handsheet, 555 S.-R. freeness
8	44.4	33	Bleached sulphite handsheet, 555 S.-R. freeness
9	52.6	39	Bleached sulphite handsheet, 555 S.-R. freeness
10	62.0	45	Bleached sulphite handsheet, 555 S.-R. freeness
11	77.8	54	Bleached sulphite handsheet, 555 S.-R. freeness
12	40.4	29	Bleached sulphite handsheet, 243 S.-R. freeness
13	41.7	32	Bleached sulphite handsheet, 415 S.-R. freeness
14	44.9	37	Bleached sulphite handsheet, 820 S.-R. freeness

RESULTS

Measurements of Weston ($1 - T$), Densichron T, and of $C_{0.89}$ (TAPPI opacity) and C_p (printing opacity) were made on a series of 38 papers. The contrast ratios were determined with a standardized Bausch and Lomb opacimeter. Each sample consisted of an opaque pile of sheets which, beginning with the first sheet under the cover sheet, were numbered 1, 2, . . . 10. Measurements were made on the central spots of these ten sheets (one reading per sheet) and the ten data were averaged to obtain the result for the given paper as measured by a given instrument.

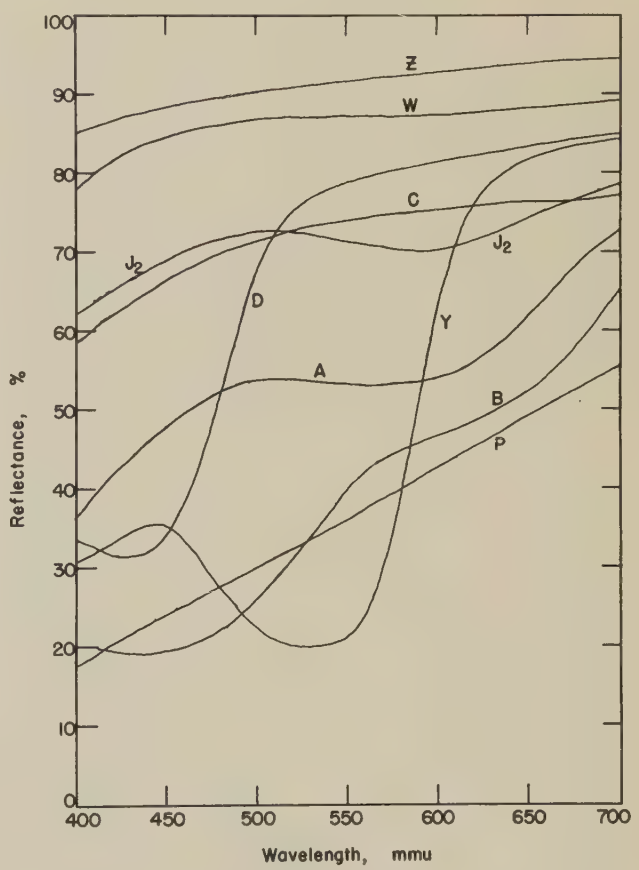

Fig. 3. Spectral reflectance curves for nine of the papers used in this study

The papers are briefly described in Table I. It will be seen that they covered a wide range in basis weight, thickness, and type.

The spectral reflectivity curves for nine of the papers are presented in Fig. 3.

The opacity data obtained with the three instruments

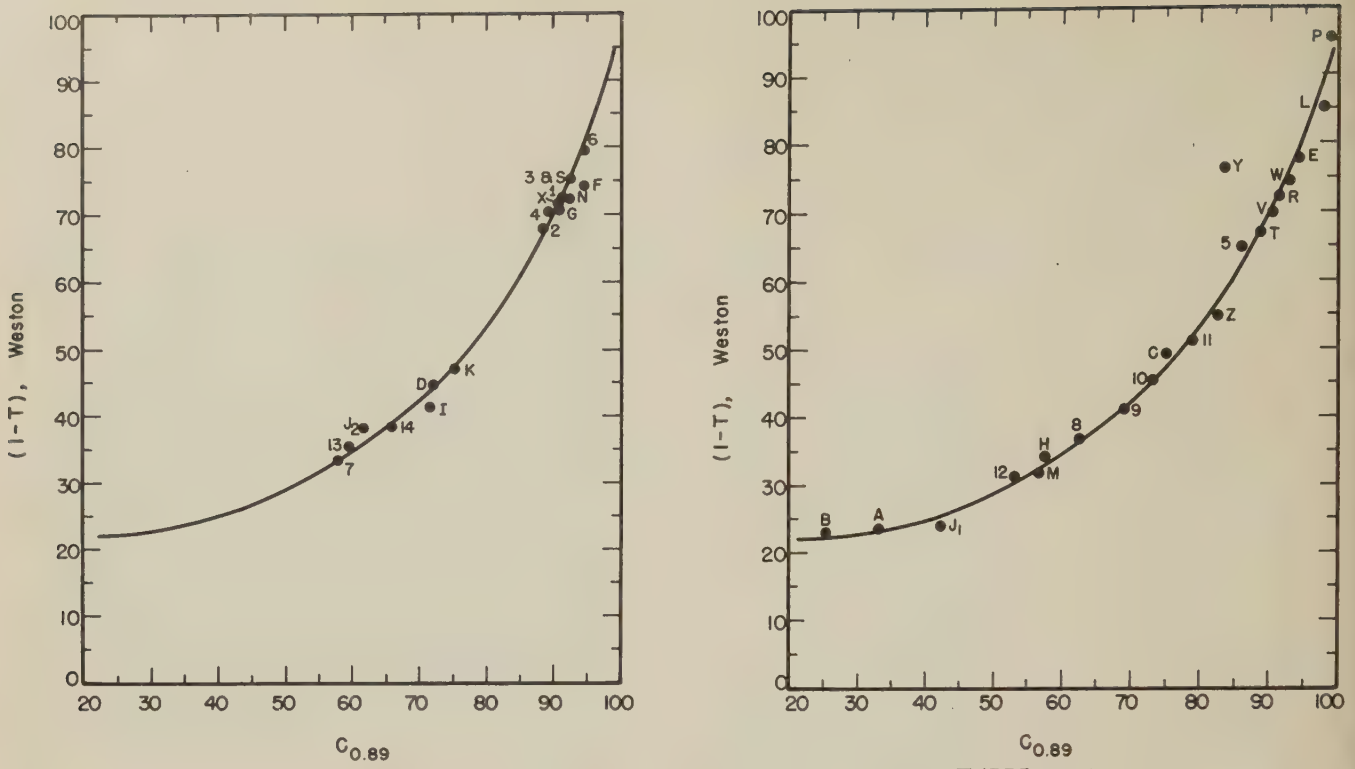

Fig. 4. Weston opacity (1 — T), expressed in per cent, versus TAPPI opacity

are presented in Table II. The standard values of $C_{0.89}$ and C_p are given in the second and third columns; Weston opacity, with the addition of the Viscor filter, is given in the next column, and Weston opacity determined with the instrument as received is given in the fifth column; Densichron T is given in the sixth column, and the last two columns present data obtained with the Densichron equipped with red and yellow filters, respectively. The data of Table II are plotted in Figs. 4 to 7. Figures 4 to 7 are divided into two charts to avoid confusion of the points. The solid lines appearing on the two charts for a given figure are identically located; these are the lines of best fit—they were originally drawn upon a carefully constructed chart containing all the data for a given correlation.

Figure 4 presents the Weston data (with the Viscor filter) (expressed as a percentage) versus the TAPPI opacity. Figure 5 presents the same data versus the printing opacity. Figure 6 gives the Densichron transmission (expressed as a percentage) versus the

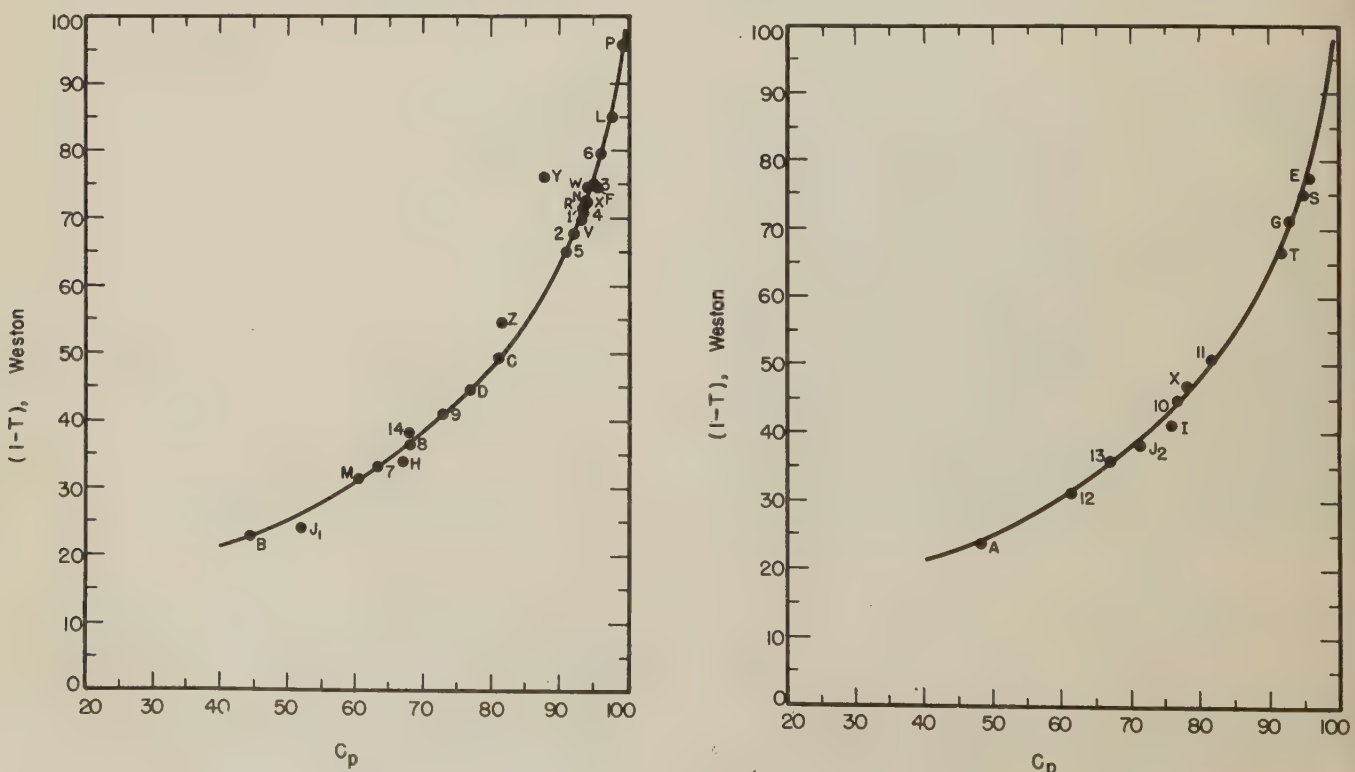

Fig. 5. Weston opacity (1 — T), expressed in per cent, versus printing opacity

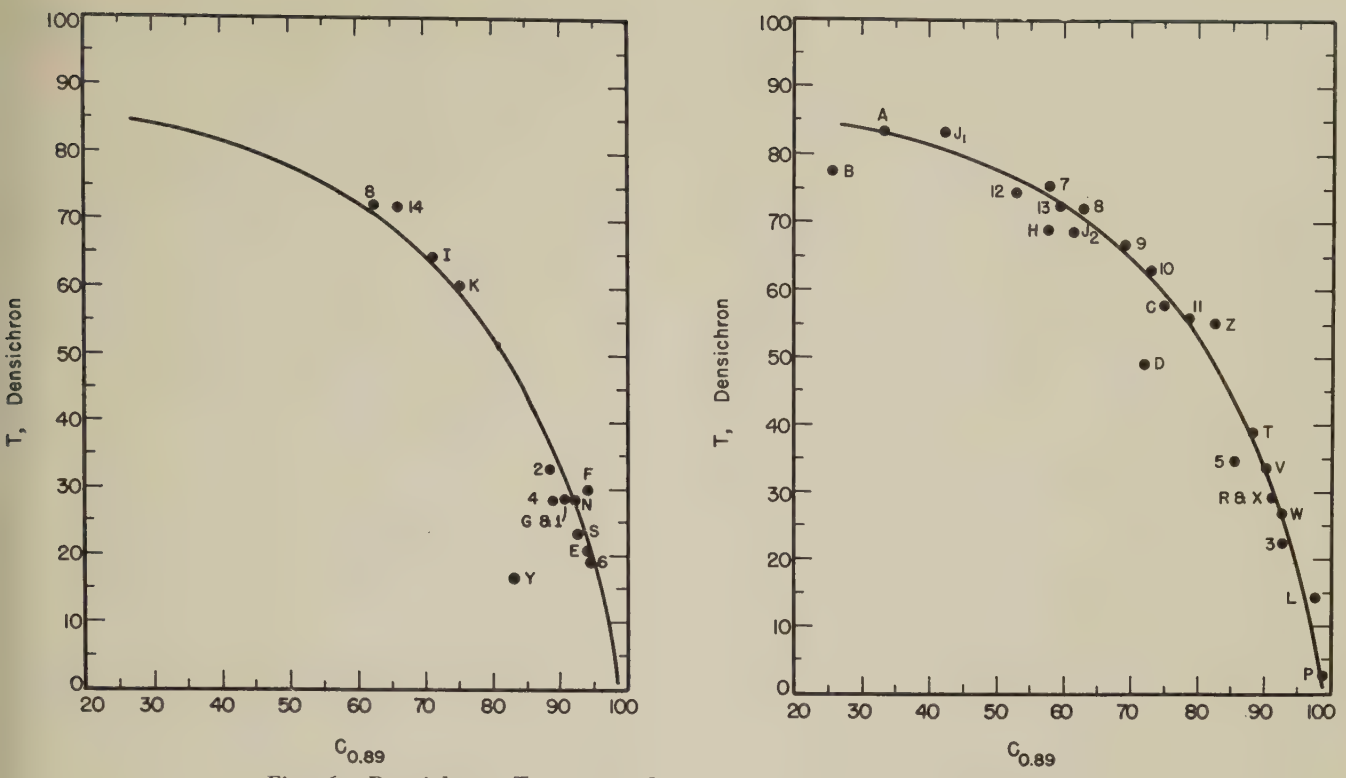

Fig. 6. Densichron T, expressed in per cent, versus TAPPI opacity

TAPPI opacity. Figure 7 presents the same data versus the printing opacity. The correlation is generally quite good. However, some of the individual deviations are too large for purposes of research or for commercial specifications. Where there is no correlation for a given paper, one has no *a priori* basis for judging whether or not that particular paper will adhere accurately to a general correlation. Furthermore, there is no assurance that a general correlation curve, established today, will be accurate after the passage of a number of days or weeks, even though the papers remain similar in all respects.

Certain deviations are readily understandable. For example, paper Y is red, which means that its opacity varies strongly from a high value in the blue portion of the spectrum (where the absorption of light is great) to a moderate value in the red portion of the spectrum (where the absorption of light is small). Both transmission instruments measure too low a value of T for this paper. The spectral response of the Densichron,

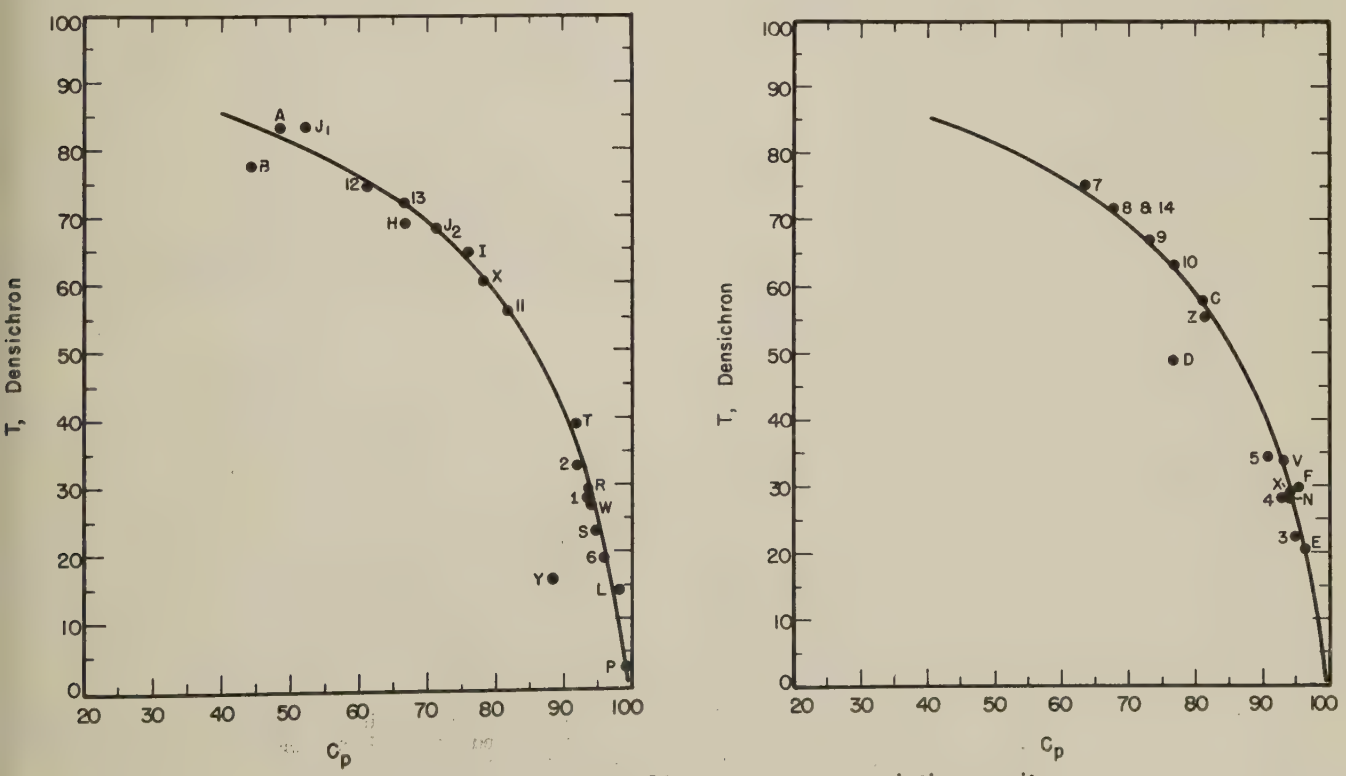

Fig. 7. Densichron T, expressed in per cent, versus printing opacity

which may be varied by the manufacturer, was relatively too great in the blue portion of the spectrum in the instrument studied to be most effective for opacity measurement. Thus, as may be seen in Table II, the addition of a yellow or red filter caused a strong change in the measured T, in the expected direction, in papers D (yellow) and Y (red). Without doubt, the correlation of the data obtained with the Densichron and the Bausch and Lomb opacimeter could be improved by adjusting the effective wavelength of the response of the Densichron. A similar comment could be made for the Weston opacity meter, although this instrument has an effective wavelength much closer to the proper value (vicinity of 560 mmu). In any event, one could not hope to obtain a near-perfect correlation for papers of all colors by merely adjusting the effective wavelength, because other considerations are involved.

Table II. Opacity Data

Paper	$C_{0.89}$, %	C_p, %	Weston (1 − T) Viscor	Weston (1 − T) No Viscor	Densichron T	Densichron T Red filter	Densichron T Yellow filter
A	33.4	48.5	23.6	22.1	83.2	86.5	83.9
B	25.5	44.4	23.2	23.0	77.5	90.6	85.1
C	75.1	81.0	49.1	..	57.6	..	..
D	72.2	76.7	44.5	45.5	49.0	65.7	61.6
E	94.1	96.2	77.7	..	20.4	..	..
F	94.2	95.5	74.3	..	29.8	..	..
G	90.5	93.1	70.8	68.0	28.2	..	33.9
H	57.6	66.8	33.8	31.1	69.0	..	69.3
I	71.4	76.0	41.1	..	64.7	..	..
J_1	42.4	52.1	24.0	..	83.3	..	..
J_2	61.7	71.3	38.0	35.8	68.4	69.4	66.8
K	75.3	78.3	46.9	43.5	60.1	..	59.6
L	97.8	98.3	85.1	82.8	14.2	..	16.0
M	56.5	60.4	31.3	..	..	..	..
N	92.3	93.9	72.4	..	28.2	..	..
P	98.9	99.3	95.6	..	2.6	..	..
R	91.2	93.9	72.0	..	29.3	..	..
S	92.6	95.0	75.1	..	23.1	..	..
T	88.6	92.0	66.6	63.5	39.0	44.4	38.1
V	90.4	93.3	69.8	..	33.6	..	..
W	92.8	94.2	74.3	..	26.8	..	..
X	91.6	94.2	72.4	69.9	29.3	38.1	..
Y	83.5	88.0	76.2	67.7	16.3	57.8	21.5
Z	82.5	81.4	54.5	52.9	55.2	54.8	51.6
1	90.5	93.6	71.5	..	28.1	..	..
2	88.5	92.1	67.7	..	32.8	..	..
3	92.7	95.1	75.2	..	22.4	..	..
4	89.2	93.5	70.4	..	28.3	..	..
5	85.7	90.9	64.9	..	34.5	..	..
6	94.6	96.2	79.5	..	19.0	..	..
7	58.0	63.5	33.3	..	75.4	..	74.7
8	63.1	67.9	36.6	..	72.0	..	..
9	69.1	73.1	41.0	..	66.9	..	..
10	73.1	76.9	45.1	..	62.9	..	..
11	78.9	81.8	51.0	..	56.0	..	..
12	53.0	61.4	31.0	..	74.4	..	..
13	59.7	66.9	35.4	..	72.2	..	..
14	66.0	67.7	38.1	..	71.9	..	..

The correlation of the Densichron data with the contrast ratios would undoubtedly be somewhat better if the instrument did not suffer so large a linearity error; to a great extent, however, the line of best fit has "absorbed" the linearity error, which does not change rapidly with indicated transmission.

The reader is cautioned against using our Figs. 4 to 7 for the purpose of obtaining a contrast ratio from data obtained with either a Weston opacity meter or a Densichron. Embarrassing errors may result because of differences between instruments or because of the peculiarities of the paper whose opacity is to be measured.

For like reasons, consumers and manufacturers of papers are urged not to incorporate in commercial specifications opacity limits in terms of transmission (or in terms of $1 - T$ or $1/T$).

The main purpose of the charts presented in these figures is to aid one in determining whether or not the two transmission instruments will serve satisfactorily in the mill control of opacity. When used with *frequently checked correlations for the papers in production,* it appears that (1) the Weston opacity meter would be satisfactory and (2) the Densichron would be satisfactory if used with a filter or phototube designed to yield an effective wavelength nearer the vicinity of 560 mmu and if the "Magnephot" were improved to reduce the linearity error. These conclusions presume that the previously discussed conditions for steadiness of operation exist.

CONCLUSIONS

1. A transmission instrument may not be employed without frequent calibration against a standardized opacimeter for accurate indirect measurement of contrast ratio.

2. When employed with frequently checked calibration for the actual papers in production, a stable transmission instrument may be used for the mill control of opacity.

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This report is one of a series issued as a part of the Instrumentation Program of the American Paper and Pulp Association. The data in this report were presented to the Association as Report No. 22, Part III, dated Feb. 1, 1950.

Paper and Packaging Specifications

U. S. Government Specifications

Following is information from Robert B. Hobbs, Acting Chief, Paper Section, National Bureau of Standards, on Federal specifications of recent issue:

UU-C-128b* (*Revision*), *Cards, Index; Price, 5 cents

The principal technical changes are the deletion of "fawn" and "pink" from the list of colors; the reduction of the minimum permissible pH value for white cards from 5.0 to 4.8; the establishment of tolerances, ±5% on basis weight, and ±0.0005 inch on thickness; and a small reduction in bursting strength requirements for chemical wood (Grade D) cards. Packing and packaging requirements have been revised, particularly for procurements by military agencies.

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Calendar of TAPPI Meetings

NATIONAL

Seventh Engineering Conference, Morrison Hotel, Chicago, Ill., October 13–16, 1952.

Fibrous Agricultural Residues Conference, Northern Regional Research Laboratory, Peoria, Ill., October 27–28, 1952 (Rooms at Pere Marquette Hotel).

Alkaline Pulping Conference, Mobile, Ala., November 12–14, 1952.

LOCAL SECTIONS

LAKE ERIE SECTION:
May 22–23, 1952. Carter Hotel, Cleveland, Ohio.

DELAWARE VALLEY SECTION:
May 24, 1952, Engineer's Club, Philadelphia, Pa.

MAINE-NEW HAMPSHIRE SECTION:
June 20–21, 1952, Belgrade Lakes House, Belgrade Lakes, Maine.

EMPIRE STATE SECTION:
(Eastern District) May 22, 1952, So. Glens Falls, N. Y.
(Central District) June 6, 1952, Syracuse, N. Y.
Annual Meeting, June 18–21, 1952. General Brock Hotel, Niagara Falls, Ont.

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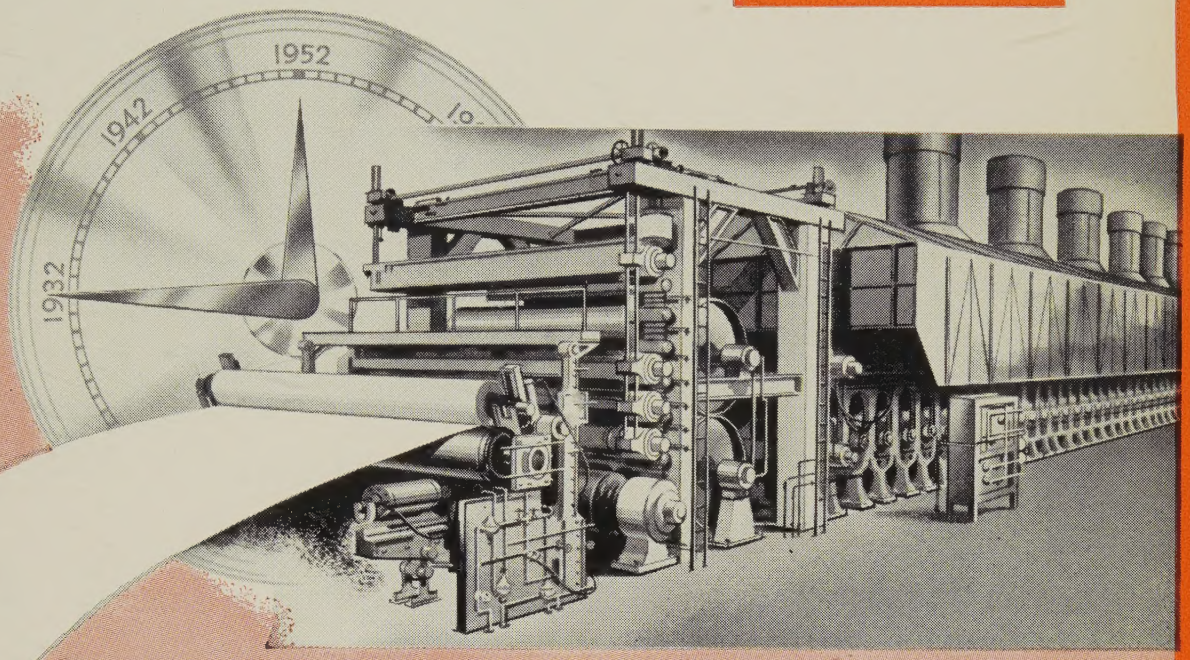

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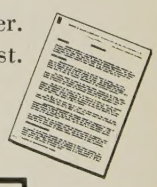

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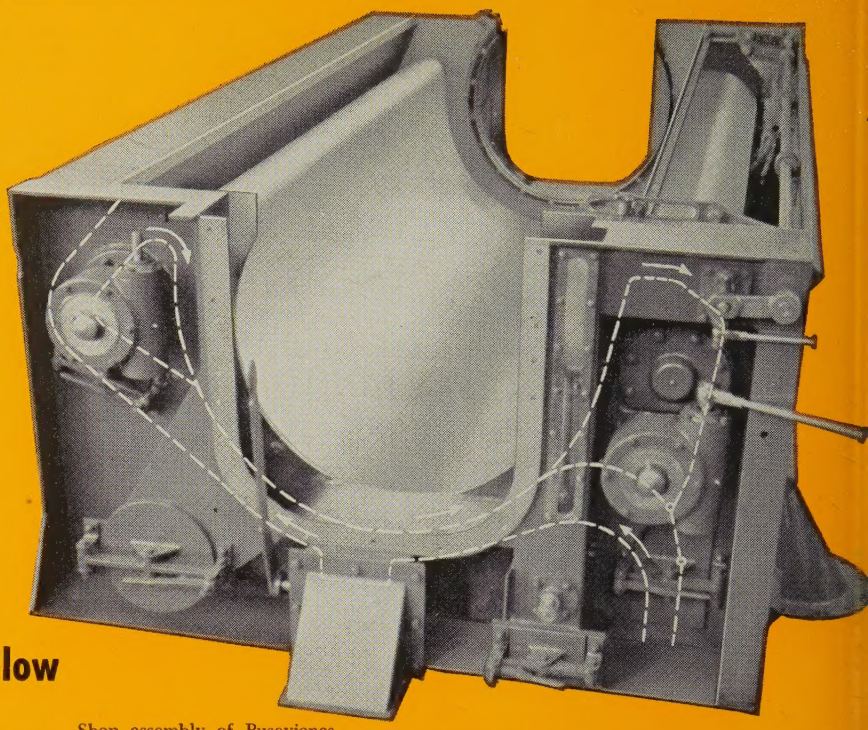

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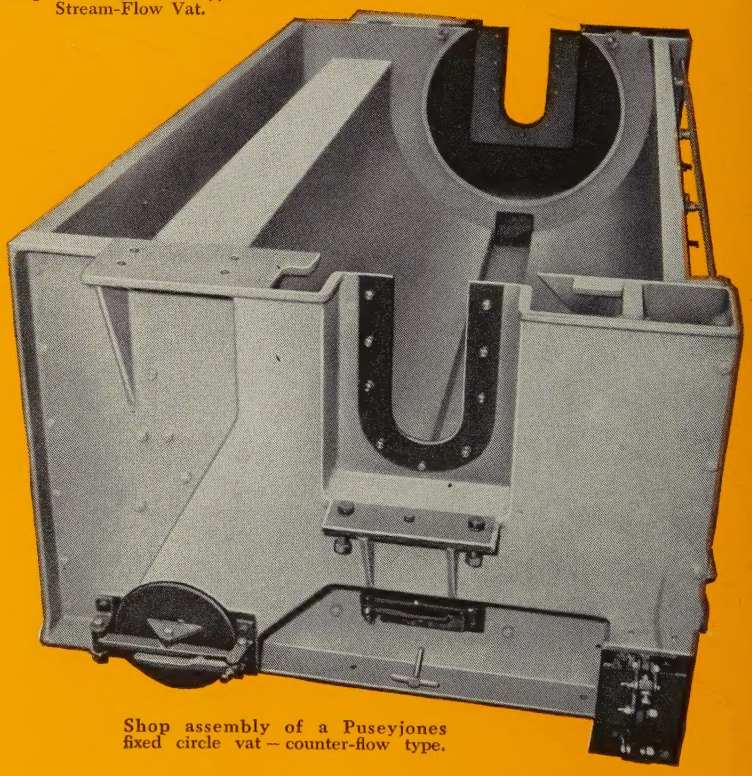

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